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17 June 1982

West Europe Report

SCIENCE AND TECHNOLOGY

No. 107

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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 107

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INDUSTRIAL TECHNOLOGY

TRANSPORTATION

BIOTECHNOLOGY

REPORT ON ORGANIZATION OF EUROPEAN BIOTECHNOLOGICAL RESEARCH

Paris L'USINE NOUVELLE in French Mar 82 pp 12-13

[Article by Michel Dabaji: "Biotechnological Research: Europe Has Some Ideas"]

> [Text] Perhaps we could take some lessons from what is happening in the great laboratories of our European neighbors, not so much from the research topics--we probably have the same kinds of research in France--but from the other elements: Might there not be some cases in which they have used originality in solving the problems of technology transfer, efficiency and organization?

The themes chosen were very specific: biotechnologies and agro-nutrition; enzyme engineering and fine chemistry; production and selection of seeds. Then around each of these themes a team was organized of about 10 French research specialists from both the public and private sectors. Then, for each theme, two delegations went abroad for 1 week each to "assess the state of advancement of these techniques in Europe" by visiting laboratories and industrial companies considered to be "in the vanguard," at least on our continent.

When we also realize that for each of the first two themes, for example, 5 countries and 11 laboratories were visited, or that the sectors of activity covered by the laboratories visited by the agro-nutrition delegation ranged from meat to additives, with opportunities to view yeast manufacture, methanization and the dairy industry along the way, at such places as Gist Brocades, ICI [Imperial Chemical Industries Ltd.], GBF (Institute of Biotechnology, Munich), and Zurich Polytechnic (ETH [Federal Institute of Technology]), or Tate and Lyle, Carlsberg, Novo, Akzo, Dechema-Frankfurt, the University of Lund (Sweden), etc., we see that the National Association for Technical Research (ANRT), organizer of these trips, did things well and that there was certainly something to satisfy even the fussiest delegate!

Those who were able to participate seemed satisfied, or at least the ones who appeared at a conference held recently in Paris and presented a "preliminary report" on these visits pending the final technical report, which will be published very shortly.

The first conclusion is that even though the enterprises and public services visited (despite the breadth of coverage) naturally did not represent the entirety of European research being performed in biotechnologies, and more

particularly even though many of the activities will evidently remain confidential, it was possible to "get an idea of trends." Thus, Pierre Monsan, of INSA [National Institute of Applied Sciences], who as a member of the university community joined the enzyme engineering delegation, was particularly attentive to research topics. In particular, he remarked on the efforts of Ciba-Geigy, ETH and Organon (of the Akzo grou) as well as Carlsberg, GBF and Novo.

On the other hand, Pierre Galzy, another academic (a professor at ENSA [National School of Agronomy] of Montpellier) in the agro-nutrition group, concluded on the basis of the "great European successes" that a small number of factors are necessary to the development of a new industry. That is, there may be an industrial tradition: Gist Brocades produces baker's yeasts and Novo produces insulin, and "the experience acquired in research, production, and marketing has made it possible to expand their fields of activity." There can also be access to raw materials under favorable circumstances: "The most spectacular example is that of ICI, which had North Sea methane and..an advanced process for obtaining methanol from that methane." That gave ICI the ability to leap, as it has done, into producing proteins from microorganisms grown on methanol. A third factor, according to Galzy, is that "it is necessary to organize teams of scientists and high-level technicians and give them the resources--at Gist Brocades, 10 percent of the personnel are in research!"

He offered a number of remarks on the organization of this research. "In the five countries I visited, research was carried out in direct cooperation with industry...There was even a case in which one enterprise, Tate and Lyle, had established its laboratory in Reading (Great Britain) at a university!" Though work on selection of strains and perfection of principles and processes may be the business of a public laboratory, development generally remains the province of industry. And "we often found pilot workshops, used for constant improvement of processes, located alongside production facilities."

As for financing, Galzy remarked that "in general the state furnishes the premises, the fluids, the overhead and a share of salaries and equipment. For operations, the sources are different, but there are automatic, renewable state subsidies and always some private contracts, which everyone told us are completely essential. Finally, it happens that some researchers are recruited just for the duration of the contract, which in general is awarded after a call for proposals on top-priority themes. "The only exception was that in Switzerland a public laboratory could ask the supervisory body to approve a program on an original subject not included among the top-priority subjects."

A Desire for Concrete Applications of Research

Also, in general not much of the work is cooperative, and thus there is not much dissemination. "Furthermore, with people trying to proceed very quickly, they fail to examine the risks. Only at ETH, for example, were they concerned with knowing how the strains obtained by genetic engineering behave under conditions close to those of industrial cultures." There are some exceptions: Kulmbach (FRG), a center specializing in meat in all its aspects, publishes all of its findings, even if acquired under contracts! Carlsberg (funded by the Carlsberg-Tuborg breweries but operating under articles of endowment) specializes in all the problems (even noise!) of the malthouse and brewery, but its

findings are available to competitors throughout the world! The same is true for Tate and Lyle (sweeteners). "In these three cases, all of the research is conducted with a desire for concrete applications; links with industry are encouraged." On the other hand, at GBF or ETH, multidiscipline activity comes first: "A framework that is better suited to relatively unorthodox ideas and that enables the research findings to be applied in several sectors."

Bernard Malige, director of research at Fromageries Bel, saw the same things as Pierre Galzy--substantial resources, participation by the state, research oriented toward industry "even in the public labs," quasi-generalization of contracts with or without confidentiality. "In the FRG and in Switzerland we even found some French researchers on extended stays in some specialized laboratories, one of them having been sent by a manufacturer in the IAA [Agricultural and Food Industries]." While he noted that manufacturers like Tate and Lyle, ICI or Gist Brocades evidently poured enormous resources into research, Malige was struck by the size of the pilot installations: "Without a large capacity, they repeatedly told us, it is not possible to extrapolate the research and demonstrate feasibility." He also remarked that at Kulmbach, which is also concerned with product control, the departments are run by a director appointed for 2 years and not eligible for reappointment.

But above all, as a real dairyman, Malige could not help but be impressed by the visit to the applied research center of DDS (a Danish company that manufactures ultrafiltration membranes): "On the same site was the largest plant for the treatment of whey by ultrafiltration, Danmark Protein. This was not just an accident!" And they insisted that the collaboration between the manufacturer (DDS) and the user pays off. "At the DDS research center, established in 1980 (15 persons), we visited autonomous test benches capable of treating 1,000 to 3,000 liters/hour of milk. A third of the area was reserved for pilot plants."

Malige saw several clients of DDS. The most remarkable certainly was Danmark Protein (an equal partner of Kali Chemie and Fromageries Danoises), which since 1979 has treated a million liters of whey per day: "They had 2,200 square meters of membranes and two fluidized bed drying towers, with everything run by computer; the powder is being used by Kali in a confidential application."

Jean-Paul Leroux (an enzyme delegation member from ELF [French Gas and Lubricants]-Bio-industries) put more emphasis on the organization of the research. "At Lund, which is a university laboratory," he explained, "people work in isolated enclaves that carry out a project from one end to the other. The enclaves are almost like small or medium-sized industrial enterprises; if the process is sold, the person in charge of the project takes part in its development at the factory level. There even exists a system to see that the researcher who thus enters the private sector will not be penalized relative to his colleagues--on the contrary." There is a drawback, however--too much compartmentalization, which isolates the teams.

Akzo, it seems, was very "open" about proposing licenses or collaborations. As for Carlsberg, Leroux was struck by its "peculiar" articles of endowment: "It is a laboratory operated by a private firm, which is a foundation..and

which in turn has founded a company to develop one of its processes." But Novo (Copenhagen) was the most impressive of all, since "first, it is a research center where the experimentation facilities include 30 fully automated 500-liter fermenters. I have never seen such a setup." Moreover, it is organized not as separate enclaves but by broad technology areas (microbiology, enzymes, etc.) so that nothing is left out. "And then, to top it all off," concludes Leroux, "Novo has an evaluation board, which apparently has substantial powers. It meets every 3 months (that is, at short intervals) to evaluate the projects --to modify them or decide to abandon one of them. A project may be abandoned even if the preliminaries are 80 percent complete." Of course, Novo is a manufacturer, and perhaps that explains it.

9828
CSO: 3102/208

EUROPEAN STRATEGIES DIFFER ON TECHONOLOGY-FOR-MARKETS CONCEPT

Paris L'USINE NOUVELLE in French 1 Apr 82 pp 59-61

[Article by Eric Le Boucher: "The End of Nationalisms"]

[Text] It is tempting for an electronics enterprise to acquire a patent, a license, or a technology abroad. A large number of technologic transfer agreements are signed every day. But the game can be dangerous: a new form of domination is being created.

Each week brings its batch of agreements signed between electronics companies. Even IBM recently decided to buy Japanese robots and resell them under its label (see L'USINE NOUVELLE No 11, of 11 March)!

There are strong reasons for this profusion, which appears to characterize the advanced technology industries. "The markets are so explosive that no one can any longer do everything in electronics," explains Herve Caron, deputy director general for planning at the French IBM subsidiary. Explosive and interconnected. In fact, the formation of telematics, office automation, and robotics on the borders of the once separate audiovisual, telecommunications, and computer disciplines, has forced the enterprises to rapidly expand their lines.

Computers or automatic telephone switchboards are no longer sold without being included in a "total system" for communications. If only to maintain their market, enterprises are compelled to acquire on the outside the missing know-how and equipment which they need. In addition, the sale of foreign equipment under one's own label creates "turnover." At a time when technical progress is accelerating, and when laboratory budgets are veritable bottomless pits, the opportunity is tempting.

Indispensible and attractive at the same time, the agreements are multiplying. Each firm has thus woven dozens of bonds which form gigantic spider webs on a worldwide scale. The confusion, however, is only apparent.

It is indeed difficult not to interpret the successive agreements reached by Siemens, Olivetti, BASF, and ICI, with Hitachi and Fujitsu, as a form of surrender on the part of Europe. Nor to also infer a new strategy perfected by the Japanese companies. A strategy that is the converse of the one widely used by the Americans, who established themselves by creating subsidiaries (ITT France, IBM France,

Japanese agreements in IBM-compatible computers.

Fujitsu (Japan)	ICL (England)	Integrated circuit design and manufacturing
	Amdahl (USA)	Integrated circuits
	Siemens (RDG)	Design, fabrication
Hitachi (Japan)	BASF (RDG)	Design, fabrication
	Olivetti (Italy)	Design, fabrication
	National Semiconductors (USA)	Design, fabrication

Except for IPL, there are no manufacturers of IBM-compatible equipment except the Japanese, who are gradually imposing their technology.

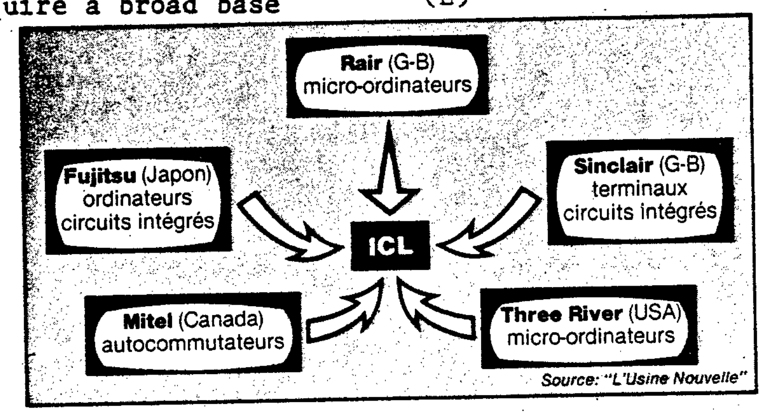
Acquisition of technologies: two examples.

ICL: rapidly acquire a broad base

(E)

(D)

(A)



(C)

(B)

Key: (A) Sinclair (England): terminals, integrated circuits
(B) Three River (USA): microcomputers
(C) Mitel (Canada): automatic switches
(D) Fujitsu (Japan): computers, integrated circuits
(E) Rair (England): microcomputers

Source: L'USINE NOUVELLE

Motorola France, and so on), and that is founded on technologic agreements. The advantage of the former approach is that the Japanese enterprises thus capture portions of the market without becoming financially involved--a valuable asset for a country whose capital resources are lower than those of the United States--while generally retaining extensive possibilities for direct exportation directly from Japan (see table).

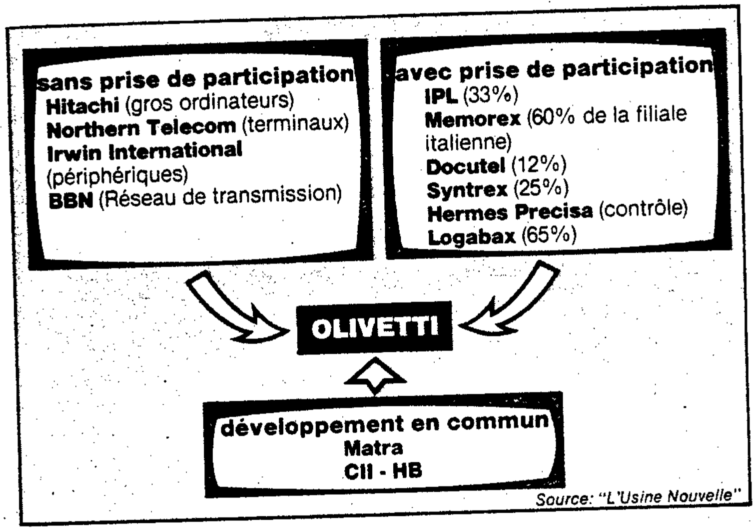
At a time when it seeks to endow France with an independent electronics industry, the government will not be able to avoid taking a position on the appropriateness of these agreements. Having rejected any form of national self-sufficiency by refusing to erect such bastions as French Telecom, French Components, or French Computers, the government has accepted that the nationalized companies participate in this international game. As Jean-Pierre Chevenement has pointed out, they will be allowed to sign agreements and seek know-how abroad.

Olivetti: pursuit of equilibrium

(A)

(B)

(C)



Key: (A) Without participation: Hitachi (large computers)
Northern Telecom (terminals)
Irwin International (peripherals)
BBN (transmission networks)

(B) With participation: IPL (33 percent)
Memorex (60 percent of the Italian subsidiary)
Docutel (12 percent)
Syntrex (25 percent)
Hermes Precisa (control)
Logabax (65 percent)

(C) Joint development: Matra, CII-HB

Source: L'USINE NOUVELLE

Is it better to buy a license or a company in order to acquire know-how? A difficult question, to which ICL and Olivetti had different responses. The Italian group often obtains participations, which assure a control of its partners.

"Copy And Then Improve"

While these agreements are attractive for the companies, they can jeopardize the independence of nations. What is good for Hewlett-Packard (to buy Hitachi patents for 64K integrated memories) is not necessarily good for the United States of America! This is preparing, for France, some delicate negotiations between the national enterprises and the Ministry of Industry. Some of the points of conflict are already defined: the large French computer, the giant videotape recorder plant, videodiscs, and standard integrated circuits.

The debate is complex. On one side, explains the director of one nationalized company, the enterprises "have two criteria for independence, which are in fact the same for any sector: freedom of movement and technical mastery." On the other side, they recognize the usefulness of a "higher," sectorial independence. For

instance, Pierre Chavance, vice-president of Alcatel Electronique, acknowledges that while the CGE group is not in the business of manufacturing integrated circuits, "French producers are still needed with plants sufficiently close to our laboratories."

Fortunately, a consensus is forming about the list of these products, indispensible both for sectorial and company independence. Integrated circuits are one of the "nodes" of the electronics industry, as Jean-Philippe Dauvin, of Bipe (Office for Economic Forecasting and Information), likes to call them. Nodes which according to him can be pinpointed, but which drift with the times. At times they move against the flow of the industry--"component mastery occurs upstream in materials (Agsa, ceramics, rare earths) and equipment"--and at times with the movement of the industry--"in consumer electronics the distribution network increasingly imposes its prices, its standards, and its image. Independent products will soon exist in electronics," he predicts.

As the touchstone of independence, the mastery of these nodes can lead enterprises to sign temporary agreements. "But if we sign technical agreements our immediate effort will be to free ourselves from them as soon as possible," adds Pierre Chavance. Because the success of this strategy of "copy and then improve" depends on the simultaneous inception of large research efforts to close the gap, and huge industrial investments to surpass in competitivity the original manufacturer.

The large French integrated circuit manufacturers who acquired American patents in 1978, are stumbling today against one or the other of these constraints. The English firm ICL, which in order to restore its position and to broaden its base and turnover sought technologies right and left (see insert), is therefore in some jeopardy. Olivetti has managed brilliantly so far; but that could well be because its director general, Carlo de Benedetti, almost always obtained participation on the part of his partners as a hold. In the agreements signed by IBM with Minolta (photocopy machine optics), with MCA (Phillips videodisc technology), or with Comsat (SBS satellite), the Number One in computers is certainly acquiring know-how. However, it very carefully creates a subsidiary with its partner to get him involved, or hires his engineers.

It is in this respect that balanced agreements are rare, especially among partners who are not so balanced. The union of CII and Honeywell testifies to it. The agreements woven by some companies, which are all too often baited traps, are part of what Georges Pebereau, director general of CGE, calls "the international division of skills."

Or in his words: "Microelectronics in Silicon Valley or the strength of the Japanese are part of a general phenomenon, and skills accumulate in zones." A terrible accumulation, which constantly increases the inequality; know-how goes to know-how as money goes to money.

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CSO: 3102/243

EFCIS SAMPLES WORLD'S FIRST INTEGRATED MODEM

Paris ELECTRONIQUE ACTUALITES in French 26 Mar 82 p 33

[Article by J. P. Della Mussia]

[Text] At the Electronic Components Salon, Thomson-EFCIS will begin to sample the first integrated modem in the world. It is a C-MOS, aluminum-gate technology circuit, referenced as EFB 7510, suitable for teletex applications and meeting the CCITT V 23 and Bell 202 standards.

This type of circuit, eagerly awaited by users particularly for directory terminals, is currently being studied by seven or eight companies in the world as an integrated format; up to now it had been offered only in a hybrid configuration. EFCIS is preparing to produce one-half million EFB 7510's in 1983, with the potential world market being slightly higher than this figure.

The circuit is designed for bi-directional simultaneous transmission of asynchronous data at 75, 150, or 200 baud for sending, and 1200 baud for receiving. Associated with appropriate line circuits, it can be used with the general automatic switching network.

Three Filters With Switched Capacitors

The need for an integrated teletex modem arose about two years ago. EFCIS introduced its design very early, using conventional C-MOS, aluminum-gate technology in order to limit the development time. The company has a very extensive line of macrocomponents in this highly proven technology, a fact that has enabled them to complete a development in less than two years, which is a relatively short time for a circuit of this complexity.

The receiving portion of the EFB 7510 includes an eighth-order input filter, a correlator demodulator (based on a 131-step digital register), and a third-order output filter. The sending portion integrates a synthesizer, a 5-bit N/A converter, and a smoothing filter in the output. All these filters are of the switched capacitor type.

And finally, the circuit integrates a time base obtained from a 12.4 MHz quartz oscillator, and a reference voltage generator. It needs a +5V and -5V supply, and has one logical and one analog section. It is presented in a DIL 18-pin package.

A Reversible Modem in Late 1982

Thomson-EFCIS is currently studying two other modems. One, called the 7511, is intended for a major German account. Its specifications are less stringent than those of the 7510, but it uses a more advanced silicon-gate technology and is remotely supplied with 4V. Its chip is very small. The other, called the 7512, joins the characteristics of the 7510 introduced at the Salon, and the silicon-gate technology of the 7511. It should therefore cost less than the 7510, which will be sold for slightly less than 50 F in large quantities.

It also has a few improvements. The 7510, for instance, has one fast channel (receiving) and a slow one (sending) which are not interchangeable. This is not important for teletex applications, but could be a problem for terminal to terminal connections, for instance. In such cases, reversibility is necessary, and will be achieved with the future 7512.

The 7512 will also have more extensive functions than the 7510; in particular, it will conform not only to the American Bell 202 standard, but also to the Canadian Bell 202, which is compatible with Telidon. The 7512 will be offered in a 20-pin package, with 18 pins being identical to the 7510. It should be sampled at the end of 1982.

It should also be pointed out that EFCIS will be second source for a universal integrated digital modem, the 7910, currently being perfected at AMD (see ELECTRONIQUE ACTUALITES, 10 April 1981). This filter should be sampled in a few months by the American company. EFCIS will sample it in turn, after 4-5 months. Mass production is forecast for one year later.

The 7910, which fulfills all the functions that could be expected from a modem, and which is therefore very complex, should be offered at about 200 F in large quantities. Its applications will therefore be different from those of the 7510 and 7512.

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CSO: 3102/240

FRENCH SUBSTITUTE FUEL PROGRAM CONTINUES

Paris AFP SCIENCES in French Feb 82 p 32

[Text] Paris--The "Gasohol" program, begun by the Barre government in January 1981 in order to perfect petroleum fuel substitutes, will be continued by the Mauroy government.

Mr Edmond Herve, minister delegate for energy, said on 19 February that the government intended to develop a "coherent and ambitious program" for developing substitute fuels.

Responding to a written question from Senator Raymond Soucaret (Left Radical, Lot-et-Garonne), Herve pointed out in the OFFICIAL JOURNAL that as of this moment the means for directing this program are in place, so to speak, and that 150 to 200 million francs a year will be spent in 1982 and 1983.

This "Green Fuel" program is justified by the amount of petroleum consumed in the transportation sector (40 million petroleum equivalent tons), and above all by automobiles (27 million petroleum equivalent tons). Until now, there has been no substitute for hydrocarbon fuels (petroleum and natural gas) which could ease France's dependence on foreign suppliers.

Mr Herve pointed out that in the weeks to come a commission for substitute fuel production would be put together, consisting of government officials, scientists, industry representatives and consumers.

The first phase of the program consists of progressively adding a small percentage of substitute products, like ethers or alcohols, to premium grade fuel, while simultaneously developing nationwide systems of production.

Thus, several projects will be undertaken in 1982 and 1983: a research platform at Soustons (Landes), pilot plants for producing a mixture based on Jerusalem artichokes, for wood gasification, for methanol and higher alcohols...

Once these tests are completed, the delegate minister for energy specified, "one can foresee the marketing of a particular new fuel, which will incorporate significant proportions of substitute products, and which will have been proven competitive."

Since last July, specialists from the government have tested these gasohol-premium blends in over 700 cars. The "Gasohol" program had been launched in January 1981 by then Minister of Industry Andre Giraud, who, at that time, drove a Renault fueled by an alcohol-premium mixture.

9939
CSO: 3102/224

FOUR MW WAVE POWER PLANT TO BE BUILT OFF SCOTLAND

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 6 May 82 p 7

[Article: "A Wave Power Station off the Scottish Coast? Britons Consider the Project Profitable/Cost Advantages for Serial Production"]

[Text] Frankfurt, 5 May--A wave power station, according to calculations by Scottish scientists, could be profitable even when compared with a diesel generator. Investigations for a site on the Scottish Atlantic coast are supposed to have shown this because costs would be less than 10 cents per kilowatt hour, as reported by the Scottish Development Agency. Now a 4-megawatt demonstration plant is planned; it presumably will be located off the island of Mull. It is said to have been designed by an engineering group at the National Engineering Laboratory [NEL] at East Kilbride near Glasgow. As further reported, a second plant of this type could be built in the South Pacific and, presumably on the basis of locally available concrete raw materials have even lower costs. Moreover, by means of serial production of 8,000-metric-ton modules in shipyards, docks, or on a simple ship, construction costs could be lowered by up to 25 percent, the Scottish scientists say.

According to the announcement, the generator developed at East Kilbride consists essentially of a 65-meter-long and 35-meter-high breakwater protruding 10 meters from the water. It would be anchored 1-3 kilometers from the coast in a conventional manner by means of rocks. The seaward side would have openings, and incoming waves would increase the air pressure in the upper part of the breakwater. The air pressure would then be used to drive air turbines. The system requires no anchoring with ropes, which is the main problem with other designs. By connecting several modules in a row, maintenance is facilitated and, in addition, a protected anchoring location is obtained.

The operators of the project have submitted the construction proposal to the British Ministry of Energy and hope that construction can start before the end of the year, so that the power station can go into operation on schedule in the winter of 1984. The ministry has already assumed a large part of the costs for an experimental wind power station on the Orkney Islands in North Scotland, and it is expected that it will bear 80 percent of the costs of the wave power station. Repayment is to be made by means of the electric current produced. The new NEL generator is part of a series of plants under develop-

ment in the United Kingdom. A more advanced system based on pontoons bobbing up and down which convert power by means of high pressure hydraulics is being investigated at the University of Edinburg by Stephen Salter. Electric current production costs estimated at this time amount to 8 cents per kilowatt-hour. The target for the completed system is near 5 cents.

5586
CSO: 3102/280

ENERGY POLICY: VIEWS ON COAL CONVERSION

Zurich CHEMISCHE RUNDSCHAU in German 15 Apr 82 pp 5-7

[Article: "Energy Policy Problems"]

[Excerpt] Coal Conversion with Many Question Marks

Among the public and in the political arena, high hopes are placed on coal conversion. Many believe that the return to coal chemistry will become possible in the foreseeable future.

From the available cost estimates for coal gasification and coal liquefaction, no sufficiently reliable conclusions can yet be drawn[14]. There is not enough experience to be able to predict the costs of large installations with elaborate environmental protection equipment. Also a factor to keep in mind is that the costs of coal gasification and coal liquefaction depend to no small extent on the price of coal (It will always take 3 tons of coal to produce 1 ton of liquid products!). If a worldwide run on coal should start, then the assumption of stable coal prices on the international markets--such as held until 1979--would have to be dropped. The price at the mine and above all the transportation costs of coal would increase sharply and the price difference between coal and crude oil and fuel oil would diminish. Such a trend break in the coal price curve (cif price) would have to be taken into account especially if the worldwide expansion of nuclear-fueled electric power plants should suffer further setbacks.

Also indefinite is the raw material base for coal conversion in the FRG. To what extent will it be possible to use lignite as the primary raw material base? Obviously, this question can only be answered when the nuclear-energy-expansion picture is clarified. It would be very unfortunate if lignite, which due to its properties is so much better suited than hard coal for gasification and liquefaction, should have to be used again in previous quantities for generating electricity. It is preferable to use lignite as the basis for coal conversion. The production of synthesis gas from lignite already appears to be near the break-even point.

14. The very optimistic economic assessment of the researchers at Gulf Research and Development Co. for the Solvent Refined Coal II process developed by them for producing the starting materials for ethylene and BTX production assumes among other things a coal price of \$ 32/t (1978 U.S. dollars). See G. A. Harris, C. E. Sinett and H. E. Swift, "SRC-II is a Promising Petrochem Feedstock Source," Oil and Gas Journal, Aug. 25, 1980, p 119 ff.

Three Central Questions for the Production of Coal Oil and Coal Gas

Along with the decisions to be made by economic policy concerning the type and amount of synthetic oil and gas to be produced from coal, there are three questions--in addition to the question concerning the economic conditions of various processes--to answer in the FRG:

--How should the investments be apportioned between the various processes for producing synthetic gas (synthesis gas, synthetic natural gas, etc.) and synthetic liquid products?

For clarifying this question, complete economic cost-utility analyses are required--as soon as fairly reliable cost estimates are available--which also include the costs for building or expanding the infrastructure and which, beyond this, attempt to evaluate positive and negative external effects.

--How can the business risk be made bearable?

In the case of large hydration facilities, projects are involved which always require an investment of DM 3 to 4 billion, if not more. The economic feasibility depends, aside from the price of coal and refining costs, decisively on the price curve for oil products. Also, in case of a worlwide increase in crude oil prices to 40 or 50 dollars per barrel (1979 price basis), the need for government aid can hardly be avoided. Then the question arises: In what form (capital subsidy, guaranty or renewed hydration preferences) should this aid be granted from the standpoint of economic effectiveness?

--To what extent should such investments be made in the FRG?

In view of the extraordinarily large space requirements and the considerable environmental pollution which--even using expensive environmental protection equipment--will occur, the prerequisites for greater expansion of synthetic oil production in the FRG are unsatisfactory. On the other hand, other industrialized countries have a comparative advantage with regard to the development of such technologies. Thus, it makes sense to explore the possibilities and opportunities for joint synthetic-oil-production projects abroad where both relatively cheap coal and the required sites are available. Limited expansion of facilities for coal liquefaction is, of course, required in spite of the FRG's comparative site disadvantages not only for assuring emergency supplies but also because the export of new technologies presumes the existence of efficient reference installations at home.

Large-Scale Experiments are Required

From the foregoing it follows that before the switches for investments in coal conversion can be confidently thrown, the foundations for the decision process must be carefully worked out. For this reason, large-scale experiments involving the various technological processes competing for the limited capital are required at home and in joint ventures abroad.

If the restructuring of petroleum refining in all industrial countries is accelerated in the future, there will be no compelling reason for increased investments in coal liquefaction and SNG production in the coming decade. The new era of coal conversion may begin--with the exception of individual forerunners in coal gasification, especially synthesis gas--only around the turn of the century or thereafter.

9160
CSO: 3102/271

STUDY CONCLUDES COAL HYDROGENATION UNECONOMICAL IN FRG

Duesseldorf CHEMISCHE INDUSTRIE in German Apr 82 p 201

[Text] From a strictly business management viewpoint, coal hydrogenation of German hard coal is uneconomical. This conclusion is reached by Veba Oel AG [Veba Petroleum, Inc] of Gelsenkirchen in a "Preliminary Study on the Construction of a Large-Scale Commercial Coal Hydrogenation Plant," which was presented to the Federal Ministry for Research & Technology. On the basis of today's costs for hard coal (German and imported) and heavy oil, as well as today's proceeds for liquid products--gasoline and light heating oil as finished products geared to market requirements--the use of German hard coal would result in an annual subsidy requirement of about DM 1.4 billion. Under various assumptions as to the use of imported coal and heavy oil, on the one hand, as well as price escalation rates for raw materials and products on the other, profitability is achieved, but only after a long initial period.

The preliminary study, in which the firms Linde, Lurgi, Veba Kraftwerke Ruhr [Veba Ruhr Power Stations], and Huls Chemical Plants also participated, showed that large-scale commercial hydrogenation of hard coal, even in combination with heavy oil according to the further developed Bergius-Pier process, is technically feasible in the FRG, as stressed by Veba Oel. However, the commercial risks which also occur when imported coal is used, even in combination with heavy oil, exceed the capabilities of a private industrial enterprise. Concerning the open questions on the further development and the optimization of large-scale commercial hydrogenation, Veba has determined that here above all the operating experiences from the Bottrop Coal Oil Plant would yield important insights.

A plant design was investigated for a coal input capacity of 3.7 million metric tons per year. The production is to be 1.95 million metric tons per year of liquid products; to secure high on-stream time, the layout is in four trains, two of which are also designed for operation with heavy oil.

A design of the coal plant for alternate use of coal or heavy oil proved not to be sensible. In such a case the plant would, for instance, have to be supplied with approximately 11 million metric tons per year of refinery residuums (TOP residuum [topped crude]). The quantities of products resulting from this (approximately 8 million metric tons per year), which would have to be further processed outside the plant, would not be usable in nearby refineries without expensive construction modifications.

The combined design of the plant has the following advantages: flexible mode of operation, conforming to the market and cost situation of raw materials; clearly lower operating losses than with a coal hydrogenation plant using only coal; contribution to the further refining of conventional petroleum through conversion of the heaviest refinery residuums into fuels, light heating oil and chemical raw materials; availability at all times for 100 percent use of coal as, for instance, in times of crisis.

The process works as follows: Coal brought in from storage after grinding and drying is mixed with oil recycled from the process under the addition of a catalyst. The mash is compressed to a pressure of 300 bars and heated to temperatures from 460 to 475°C and is hydrogenated under these conditions. The gases formed during hydrogenation (C_1-C_4) are conducted to a gas-processing unit. After separation of a hydrogen-sulfide-rich offgas, which is supplied to a Claus plant, liquefied gas and fuel gas are obtained. The fuel gas is used for firing the process heaters or for the production of hydrogen. Liquefied gas is obtained as a marketable product.

Following hydrogenation the liquid products are condensed and separated into gasoline and middle distillate by distillation at atmospheric pressure. While the middle distillate is obtained as a specification-grade light heating oil, the gasoline must be further processed by refinery techniques.

Following vacuum distillation, the coal not converted during hydrogenation, the coal ash, the catalyst and highboiling hydrocarbons are used in a gasification plant laid out in three trains for hydrogen production. The ash obtained is stored.

Investment costs for this plant, including startup costs, come to DM 6 billion (1981 prices). The personnel requirement for operation of the large-scale plant is 3,000 employees. The land area requirement is approximately 300-350 hectares. From planning to putting into operation, not less than 8 years will elapse.

The plant can be built within the limits of applicable environmental protection requirements. Gas and dust emissions are less than the allowable amounts according to TA-Air [TA--Technische Anforderungen--Technical Standards]. However, should the TA-Air be changed in the direction of decidedly more severe approval conditions, in accordance with newly proposed laws currently under discussion, this could come into question. Requirements for introduction of effluents [into the ground water] are adhered to. Requirements with respect to acoustic emissions can be met--although by means of expensive measures.

All plant sites investigated in this study (two in North Rhine-Westphalia, four on the North Sea Coast) are in principle suited for the projected plant. Completion of the plant is not assured politically for all plant sites. Public resistance would be apt to delay construction considerably, if not prevent it altogether.

5586
CSO: 3102/280

BRIEFS

METHANOL REACTOR SUCCESSFUL--The methanol reactor--until now the largest in the world--which was put into operation in the fall of 1981 is running without a hitch according to a recent announcement by Lurgi, the reactor's designer and builder. The reactor was built on the premises of Union Rheinische Braunkohlenkraftstoff AG in Wesseling and employs the low-pressure process developed by Lurgi Kohle und Mineraloeltechnik GmbH. It has a capacity of 1,200 tato. After just 3 weeks of operation, the installation could be turned over to the customer in a routine manner. Lurgi is presently building 3 more methanol facilities which likewise employ the low-pressure process: VEB Leuna (2,000 tato), Sabah (Malaysia, 2,000 tato) and Pertamina (Indonesia, 1,000 tato). [Text] [Duesseldorf EUROPA CHEMIE in German 29 Mar 82 p 142] 9160

PRIORITY FOR COAL RESEARCH--The highest growth rates in overall expenditures for energy research through 1985 will be in the outlays for coal refining, especially for coal gasification. This stems from an energy research program that the Federal Research Minister Andreas von Buelow will lay before the cabinet for ratification. According to this program, the research outlays for coal gasification will increase from DM 166 million in 1982 to DM 672 million in 1985. On the other hand, the outlay for coal liquefaction will increase only from DM 123 million to DM 163 million during the same time period. Thus, overall, the following amounts will be made available for coal refining: in 1982, DM 289 million; in 1983, DM 438 million; in 1984, DM 604 million and finally in 1985, DM 835 million. In total, the energy research program for 1982 involves DM 2.3 billion compared to DM 1.97 billion in 1981. The scheduled outlay of funds for the years 1983 through 1985 is, respectively, DM 2.5 billion, DM 2.75 billion and DM 3.1 billion. [Text] [Duesseldorf EUROPA CHEMIE in German 29 Mar 82 p 141] 9160

CSO: 3102/267

FIRST EUROPEAN FLEXIBLE WORKSHOPS, CELLS BEGIN PRODUCTION

Paris L'USINE NOUVELLE in French 25 Mar 82 pp 105-107

[Article by Patrick Piernaz]

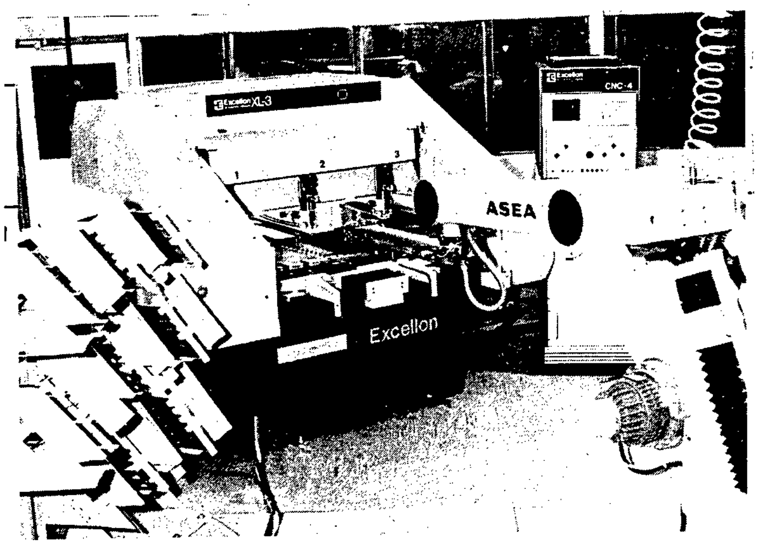
[Text] In Italy, in France, and in Sweden, the first flexible-cell shops are beginning production in the automotive, mechanical, and electronics industries. Our special correspondent at the Milan conference has the first figures and the first tallies on the new generations of production shops.

At Maserati, in Italy, the first models of the Biturbo 2000 cars are beginning to be mass produced. The announcement of this news was properly welcomed by the small world of sports cars. But this time, it is not only the esthetics and performance of the car that are newsworthy, but rather the fabrication of the six-cylinder engine: its aluminum parts (blocks, cylinders, heads) are produced in a flexible shop that has just been placed in operation at the Modena plant. The description of this installation was one of the highlights of the "Flexible Shops" conference organized in March, in Milan, by the Association of Italian Machine-Tool Builders.

This meeting made it possible to learn about the progress of Italian flexible systems, as well as about other European installations, with the exception of German ones, who after all, have several flexible shops at Messerschmitt Bolkow Blohm (aeronautics), Volkswagen (trucks), and Trumpf (sheet metal parts), among others.

In Italy, the Maserati installation was furnished by Olivetti, which installed ten Horizon 22 machining centers connected by two rail-mounted pallet carriers. This shop turn out 30 engines per day in two shifts, which corresponds to one engine every 30 minutes. Eight different parts are produced on this machine complex, with a machining time of 12-60 minutes per part. "For the user, this shop offers three basic advantages: machine operation with no idle time, the possibility of easy tooling for future parts, and the knowledge that production will continue if one of the machines breaks down," said Olivetti's Sergio di Padova.

At the present stage of the installation, the Italian firm has not centralized automation control. Each machining center is autonomous, is equipped with tool control sensors and dimension sensors, and each identifies the parts to be machined according to pallet coding. Each unit's numerical control memory stores the programs for the various parts to be machined. The next step in this shop's



Fabrication island for printed circuits at Asea, in Sweden. The robot loads and unloads two NC drilling machines.

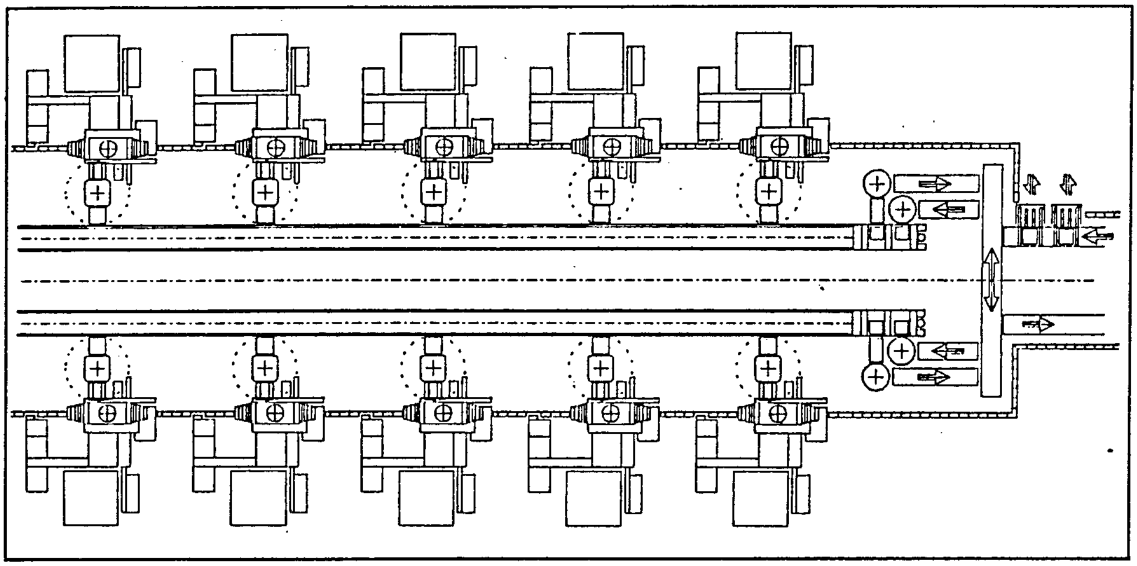
development will be centralized computer control for direct numerical control (CND), similar to the installation adopted by Comau (Fiat subsidiary) at the Iveco plant in Brescia. This shop produces 220 parts per day in two shifts, mainly aluminum and cast iron engine components, and truck gear-box housings.

Shop Design: Significance of Computer Simulation

The installation includes 12 horizontal spindle machining centers connected by a roller conveyor-belt track. It is entirely controlled by two PDP 11/34 computers, which manage the movement of parts, and depending on needs, transmit programs to the machines' numerical control through the CND system. But Sergio Romanini, responsible for Comau's flexible shops, emphasized the importance of computer simulation techniques in the design of such shops. "These programs are indispensible for optimum use of the various elements of the production system, because they allow adjustment of the major parameters: number of machines, number of pallets, speed of conveyor systems, and part dimensions. The computer makes it possible to make the best choice, and above all, to evaluate the flexible shop's productivity variations in cases of machine or component breakdown."

This opinion is fully shared by the staff of Automatique Industrielle of Suresnes, which has computer-simulated the future shop of Citroen Constructions Mechaniques intended for the Meudon prototype plant. This work has made it possible to precisely determine its configuration: it will include three machining centers, an automatic gauging machine, a surface treatment machine, an automatic 600-tool magazine, four loading and unloading stations, and will produce engine model parts (heads, gear boxes, and differential and clutch housings) in small runs of approximately fifty pieces.

This installation should start operations during 1983, which is one year later than the extraordinary installation which is being started at Renault Vehicules Industriels, in Boutheon. "This is a shop that is at the cutting edge of world technology," states without hesitation Catherine Dupont, who has worked at Renault

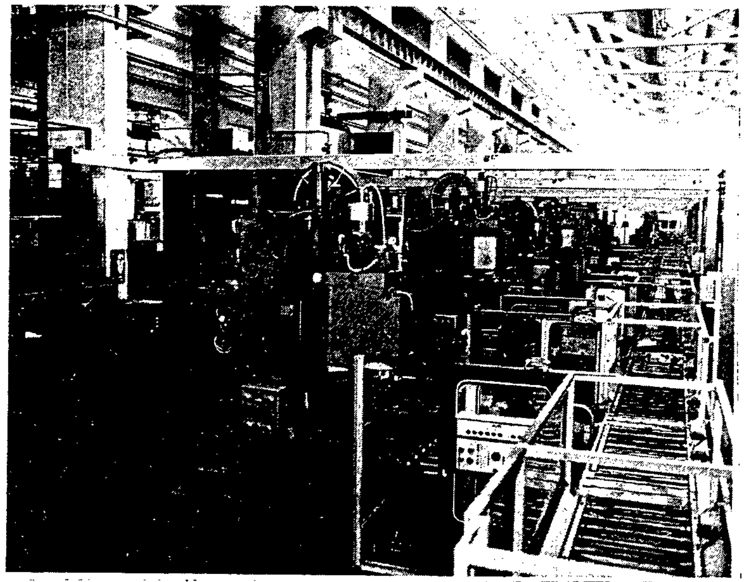


Layout of the Maserati flexible shop in Modena. The 10 machining centers produce 30 engines per day in two shifts.

Machine-Outils (Machine Tools) on the software for the shop. The original feature of this installation is that its real-time management practically eliminates stocking and work-in-progress. All the pieces machined during one day are assembled the next day in the same plant. The Renault shop will machine only the parts required for assembly, and will constantly adapt (in real-time) machining to manufacturing needs. The anticipated production is 100 gear boxes per day in four machining centers, with three special machines, a washing station, and 10 wire-guided carriages. The whole will be also managed by two computers, which will determine the pallet traffic and machine control.

But all these installations are still considered to be too large and too expensive by many enterprises, which prefer to approach manufacturing automation in stages. The first of these stages is the flexible manufacturing cell, which generally combines a robot and two or three numerical control machines. Many machine builders, such as Jobs, Comau, Asea, and DEA, have already constructed some of them.

The production island installed by Jobs at Car-Bench in Massacarraro, is a fine example of the automation of a group of machines. Its task is to machine a line of beams for garage lifts, which are 1-1.4 m long and weigh 48-60 kg. The island was assembled from two existing machines (a milling and a boring machine) and a JOB'OT 10 robot. The latter picks up the parts from a pallet, presents them to the two machines, deburs them at the end of the cycle, and loads them on pallets before they are moved to the surface treatment station. "The parts are machined at the production island without any manual intervention," points out Antonio Dordoni of Jobs-Quota. "Car-Bench was thus able to double its production with a 70 percent investment savings, an 80 percent manpower costs reduction, and a 50 percent gain in floor space."



Flexible shop built by Comau for the Iveco plant in Brescia: 220 parts per day, produced with 12 machining centers.

Flexible Cell Concept Applies Not Only to Machining

Asea has applied the same principle at its plant in Vasteras, Sweden, for the printed circuit manufacturing shop. "This island is particularly interesting," states Johan Halling, Asea director in Vasteras, "because it operates 3 x 8 in eight-hour periods without operator control, and especially because it is supervised by a computer and integrated into a complete system for computer-assisted design and fabrication (CAD/CAM). The industrial robot prepares the stacks of interleaved and printed circuit cards by drawing from various magazines, loads and unloads the two numerical-controlled drilling machines, changes drills, removes finished parts, and so on."

Similar applications were described during the conference, notably by Comau, which has two pilot flexible cells, one in its Turin plant (brake disk machining, loaded by robot), and the other in Modena, where a robot connected to two numerically controlled lathes changes parts and replaces cutting tools.

But the flexible cell concept does not apply solely to machining. For instance, DEA Automazione, a manufacturer in Moncalieri (near Turin), has sucessfully installed 22 systems for assembly and automatic control with robots. Among the most recent of these, are those for engine head assembly (valves, springs, and rocker arms) at Comau, which uses four manipulators, and those for electric motor assembly at Ibimei (13 parts to be assembled) at the rate of 150 per hour.

Machine-Tool Builders Equally Interested

The development of flexible shops and cells is of interest to machine-tool builders as well as to the manufacturers of numerical controls, who must design equipment and software adapted to these new forms of production. Such is the case of ECS in Florence, which has developed a number of computer programs: a machine program called Main, a program for machine diagnostics and configuration, and so on. Similarly, Num SA has perfected flexible shop options for its CNC 640: choice of programs (256K-word memories), tool management (wear, working time, and presence control), parts and base-line measurement by means of sensors, and so on. Moreover, Num has perfected a direct numerical control system capable of connecting 16 numerical control machines to a central unit. Several applications are being developed at Renault, Peugeot Cycles, Citroen Meudon, and Snias Marignane. At the same time, one of the large European specialists, Elsag, has developed special modules for its numerical controls. These combine the necessary software and equipment for unsupervised operation: part control modules, tool control, power monitors, and so on. And for the more advanced systems, Elsag has devised a direct numerical control architecture to guide several numerical control machines. It is presently undertaking two installations at Leroy-Somer in Angouleme, and at Gilera, in Arcore (Italy).

11,023
CSO: 3102/235

FRANCE ENTERS COMPETITION IN CARBON FIBER INDUSTRY

Paris INDUSTRIES & TECHNIQUES in French 20 Feb 82 p 10

[Article by Alain Perez]

[Text] Five hundred tons per year in 1985; two producers for a strategic material that is still very expensive.

On my left, Elf with 250 tons. On my right, Puk with 200 tons. For France, 1981 will remain the year of the carbon fiber. One after the other, these two groups announced their plans: by 1985, we will thus have gone from nearly nothing to nearly 500 tons per year. "Not one gram of foreign fiber will come into France," they say at the Ministry of Industry. "The users will have to play the game."

The two future competitors have solid allies: an American and a Japanese one for each. On the Elf side, they are playing the Union Carbide/Toray card. At Puk, they are betting on Hercules/Sumitomo. Two three-way unions for a European market that has not really been opened yet. The large users are not so sure that the two trios will make it all the way.

Under the Eye of the Ministry of Defense

The Ministry of Industry is responsible for this frenchification. "We had established the rules of the game. We had two suitors. A ruling in favor of one or the other would have been inexplicable." The Ministry of Defense, very concerned by this "very strategic" material, followed the negotiations from the start, but for the time being the independence will remain only partial.

In both cases, the polyacrylonitrile (PAN) will be supplied from Japan by Toray and Sumika (Japanese subsidiaries of Hercules and Sumitomo). An eventual know-how transfer is anticipated for this indispensible basic fiber. The two agreements are valid for 10 years. They theoretically give the two French groups complete access to the American and Japanese technologies. There are already several big losers in this matter: first, Serofim, the only current French producer, which will be reintegrated into the Puk fold; second, Rhone-Poulenc, which vanishes completely from this field. This French company now seeks to catch up by associating itself with a partner, to produce in France an aramid fiber complementary to carbon fiber: made-in-France Kevlar could soon see the light of day.

Another loser is the English company Courtaulds, inventor of this material, "which did not know how to carry out the negotiations." And finally, the Ciba and Hoechst groups are also in the race to acquire one of the famous licenses. There is neither chance nor kindness in these implantations. France is the largest consumer country in Europe, with 40 percent of the 200 tons currently being used each year. According to GIMAC (Interministerial Group for Composite Materials) estimates, this figure should triple by 1985. The Elf project forecasts a minimum production of 250 tons per year toward the end of 1985. The plant would be located in the Lacq region, near the large Bordeaux manufacturing centers (Snias, Sep, Dassault). A late starter in the race, Puk is making very good time. Its project should be completed at the end of 1983, probably in the Lyon region. The cost of each unit is estimated at 150-200 MF. A PAN production plant would cost five times more, but both sides strongly believe in it. "It's an act of faith," indicates Bruno de Vulpian at Puk. "It's a bet on the future," thinks Mr Kaelin of Elf. Puk already has some carbon product experience, notably through Serofim. Elf is starting from scratch in fibers, but does know resins, which are completely indispensible.

The users hold the key to this double bet, and they are essentially the large aeronautics firms. Snias' bonds with Puk are long-standing, and the arrival of Hercules, titular supplier for Boeing, is favorably received. A "diplomatic" action is also being undertaken with the other large European customers (Enka, Aeritalia, Ciba), the aim of course being to convince them to buy French. Here again, Puk has a small advantage thanks to its knowledge of aeronautics circles.

In fact, and independently of the outcome of these projects, the size of the French producer or producers will remain modest. In 1985, Union Carbide, Toray, Hercules will grow beyond 1000 tons per year. And this does not even take into account Toho, Celanese, and Nippon Carbon. The world market is already overloaded. How will it be in 1985?

Aeronautics First

In any case, the penetration of carbon fibers into aeronautics seems to be inevitable. Boeing forecasts that during the 1990's, commercial jets will require high performance composite materials for 60 percent of their weight. The substitutions will occur at the expense of aluminum.

The other large sector is automobiles. Very little is going on for the time being, because the price is prohibitive. However, the upper limit estimated by GIMAC for Europe's consumption is 1200 tons per year, assuming that usage in automobiles begins earlier than predicted.

Things probably will not really get underway before the 1990's. The other sectors (sports, leisure) manage very well with a lower quality but definitely less expensive fiber, made from resin or rayon.

The whole problem lies in the fabrication process. The PAN approach yields very expensive, high-quality fibers (300 F/kg). To generalize the use of this material, the price would have to be divided by 10 or 15. All the participants will not be able to engage in the coming price war. Recently, a Japanese laboratory presented a promising original process: it is an experimental gas-phase technique (benzene cracking and crystal growth on a metallic seed), which eliminates all the complex operations of carbonization and drawing. The history of French carbon fibers is only beginning, but the Americans and the Japanese are in clover.

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SECOND-GENERATION ROBOTS APPEAR ON SCENE

Paris INDUSTRIES & TECHNIQUES in French 1 Mar 82 p 10

[Article by Jacques Houbart]

[Text] They are Characterized by New Visual and Tactile Capabilities.

The second generation robots that are now appearing on the industrial scene are characterized by new visual or tactile capabilities. These advances in sensing abilities were pointed out by Mr Parent, of the Agence de l'Informatique, during a conference on Industrial Applications of Artificial Intelligence (CERN, Geneva).

American and French in the Lead

As Mr Parent stated just before his departure for Geneva, "the current leaders are a few American and French teams. Following the Unimation research, Automatics has perfected seeing equipment, notably for Asea. In France, an Acma robot can already locate and grab a crankshaft from a semi-jumbled pile on a pallet."

At Souriau, a three-fingered hand is equipped with tactile sensors, the tactile sensing being transmitted by fiber optics. Programming advances explain the observed entry into the field of robotics, of such companies as TITN, GIXI, or Adersa-Gerbios. The recourse to programs using sensor data justifies GIXI's ambition to create universal robots.

At Adersa-Gerbios, the gains made in the vision domain are being fully exploited. A digitalization of the video image pretreats the scene by selecting the essential features of the information. "We are striving," says Mr Roux, "to design equipment competitive in price, which will be used in industrial work stations, and notably a device that will enable the control of a robot arm as a function of the shape of the parts being identified."

This enterprise is developing a system for automatic recognition of large beef carcasses; the objective is to automate the carcass classification station by eliminating subjective criteria. Another program uses the machine's ability to "see

the human eye" and therefore to recognize the texture of a subject's iris. This leads to the possibility of recognizing man's "iris print" in the same way as a fingerprint. Applications are already being envisaged to protect certain security areas.

Rapidly moving through the chapters of classic physiology, robotics is already advancing beyond the stage of sensing and perception, and an entirely different robotics--without information feedback--appears on the horizon. At that point, the machine will be loaded with a data base--in welding, for instance--and depending on other memorized knowledge, will be able to perform a number of tasks. But it is probable that in any case, the sensing ability of the new machines will always be brought into play.

In addition to Mr Parent, the Geneva meeting was also attended by H. Gallaire (CGE-Marcoussis), R. Prajoux (LAAS, Toulouse), Mr Burnod (SPS Division, CERN, Geneva), J. P. Haton (University of Nancy), J. Potage (Thomson-CSF, Gennevillers), J. L. Lauriere (University of Paris VI), and A. Bonnet (LRI, Orsay).

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ROBOTICS PLAN LAUNCHED WITH MEETING OF USERS, MAKERS

Paris L'USINE NOUVELLE in French 8 Apr 82 pp 59-60

[Article by Georges Le Gall: "The Robotics Plan Begins Today"]

[Text] Users and manufacturers have just met. Thanks to this concerted action with the industry, the government will be able to settle on the action programs which could be implemented before the end of this year.

The day of April 8 could be considered as the true starting point for the implementation of the robotics plan prepared by the Ministry of Industry: this is the day on which representatives of the industries that use and manufacture this equipment are meeting. They will then break up into eight specialized workshops: textiles, garments, footwear, mechanical wood processing, furniture, plastics and rubber processing, paper processing, and ceramics. It is possible that other groups will be formed subsequently, notably for agricultural food products.

Each group (which includes 20-40 persons, most of them industrialists, but experts as well, primarily from professional technology centers) will have to produce a report before the summer vacation. In addition, a general report will be written by Jean-Claude Touret, of Bipe (Office for Economic Forecasting Information).

The robotics task group created at the initiative of the Ministry of Research and Technology, must also draft a report by the beginning of summer, and will associate itself with the work being carried out by the Ministry of Industry through its chairman, Maurice Petiteau, chief executive officer of Sormel.

The government has two goals: encourage the manufacturing industries to invest massively in automatic equipment (and not only robots in the strict sense of the word), so as to strongly bolster their productivity and thus be able to improve their share of the market both in France and abroad; and at the same time, facilitate the development of a strong French industry in the new equipment sector formed by automation.

Automation: 17 percent of French production investments (in million francs)

Type of system	AA	BB
Industrial process computers	1,600	800
Machine tools	3,700	500
Machines for agricultural food products	3,000	200
Various industries (textile, shoes, printing)	3,000	200
CAD/CAM	200	200
Maintenance equipment	4,000	150
Assembly, packaging	1,500	150
Plastics and rubber	700	100
Robots	100	100
Foundries	400	50
Various (including engineering studies)	1,400	1000
Total	19,600	3450

AA = Total investments
BB = Investments in automatic equipment and software

This means amplifying and systematizing, both in demand and supply, the efforts that have already been undertaken by the previous government (notably, at the beginning of 1980, the creation of the Committee for the Development of Strategic Industries, which has aided the introduction of flexible shops and the implementation of the Meca procedure to encourage the acquisition of advanced design machinery and equipment) and by the present one (with programs covering machine-tools and the textile industry).

Profusion of Agreements Between the Giants of International Industry

According to an ADI (Agency for Computer Development), the French inventory of robots of all types amounted to about 39,000 units (17,000 in the automobile industry alone) at the beginning of this year. The manufacturers have recently become aware of the usefulness of developing a structure to coordinate innovation in the automation domain, where demand is expected to grow steadily at a rapid rate (on the order of 30-50 percent per year). This has led, in October 1981 under the sponsorship of the Federation of Mechanical Industries, to the creation of Girma (Interunion Group for Robots and Automatic Machines); and in February 1982, to the formation of Afcomis (French Association of Designers-Manufacturers of Special Machines and Installations).

The most recent months have seen a profusion of robotics agreements among the giants of the international industry: Volkswagen-General Electric, Olivetti-Westinghouse, Kawasaki-Unimation-Asea, IBM-Sankyo Seki, General Motors-Fanuc, and so on.

Faced with dealings of this magnitude, the French will be forced to reexamine the credits they allocate to automatic devices (a total of 251 million francs in 1981, consisting of 91 million for research and development, and 160 million for implementation aid); and to specify the role they want to assign in this area to such large national enterprises as CGE, Dassault, Matra, Renault, Saint-Gobain, and Thomson.

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CREUSOT-LOIRE: HIGH-QUALITY AERONAUTICAL STEELS, LOWER COST

Paris INDUSTRIES & TECHNIQUES in French 20 Feb 82 pp 94-95

[Article by Jean Nenin]

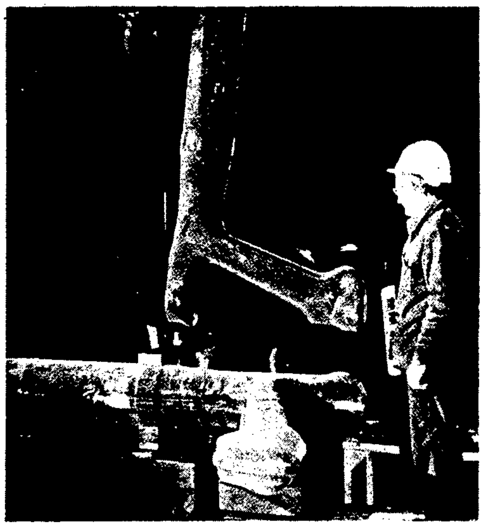
[Text] Remelting under slag with the performance of vacuum remelting, for safety parts.

The formulation of special steels in electric furnaces has evolved greatly during the last few years: very low sulfur (less than 40 ppm) and hydrogen (less than 2 ppm) contents, inclusion purity improved by the use of slag and passivation processes specially adapted to the reduction phase of the operation, deoxidation with carbon in vacuum, and so on.

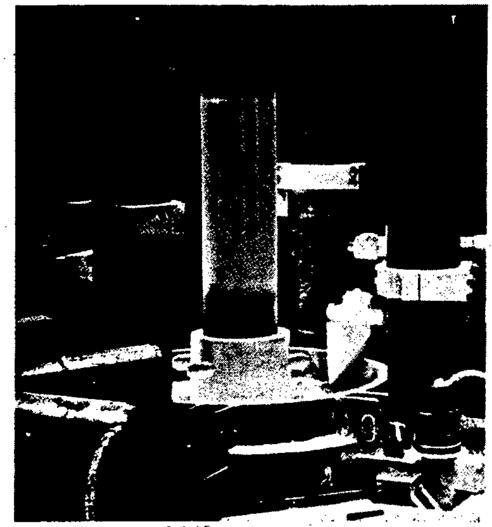
However, despite these improvements, it has remained necessary to use remelting processes in vacuum or under electrically conductive slag (VAR and ESR) for applications that require a very high level of reliability or severe service conditions. This is the case of the airplane industry in particular. The VAR process was the first to attain the "very high quality" (THQ) level, with the ESR process being used only to obtain very low sulfur contents and improve inclusion purity under the most economic conditions.

The Pamiers company of Creusot-Loire had set itself the objective of reaching this THQ level with a single ESR remelting, when only the VAR process appeared to guarantee it. They have achieved their goal in the form of a qualification and fabrication of the essential parts for the Airbus A 300 and A 310 landing gear, using 35 NCD 16 steel.

The process is characterized by the remelting of an electrode through a slag layer, which allows a purification of the molten metal drop by drop as it passes through the slag, and which results in a surface condition that avoids scaling. The furnaces of the Pamiers plant currently make it possible to produce three types of ingots without change of electrodes: 4 t squares (450 mm on a side), as well as 10 t and 30 t cylinders (700 mm and 1100 mm in diameter). The latter can reach 33 t by changing the electrode during remelting.



Airbus landing gear made of 35 NCD 16 steel obtained with the ESR-THQ process (Documents Loire).



A 30 t ingot of QAS or THQ quality, obtained from the remelting of a single electrode.

Two levels of quality can be obtained depending on the performance expected of these remelted steels: standard aeronautical quality (QAS), which represents the best cost/safety compromise, and whose cross-sectional properties take priority; and very high quality (THQ), needed for particularly stressful applications, which require a high level of fatigue resistance, as in the case of landing gear parts, for instance.

Constant Mechanical Properties

In general, and within any one level of performance, these two qualities offer a chemical composition homogeneity reflected in constant and isotropic properties, and in a structure in which regular crystallization without axial segregation over the entire length of the ingot, results in excellent transversal ductility and good resilience at all points. The ESR process developed here controls the proportion and distribution of non-metallic inclusions, and leads to a purity level comparable to that obtained with the VAR process. And finally, the skin quality of the ingots allows a direct processing without preliminary preparation for stamped or pressed products, thus reducing the cost of these operations.

The THQ level for safety parts that undergo high static and dynamic stresses, was required for the 35 NCD 16 steel in the fabrication of essential components in the landing gear train of the Concorde, and eventually of the Airbus A 300 (framework, trailing bar, articulation arm). It is characterized by a highly homogeneous chemical composition: for a 10 t ingot, for instance, analysis spreads between the top and bottom of the bar must be below 0.03 percent for C, 0.05 percent for Si, Cr, and Mo, and 0.10 percent for Mn and Ni.

This 440 kg spar mounted on the A 300 and 310, is made from 40CDV12 obtained by the ESR-QAS process.

Controlled PPM

Also required are a very low content of sulfur (less than 30 ppm; the Bauman macrography must be absolutely virgin) and phosphorus (less than 100 ppm), and a controlled content of trace elements: less than 100 ppm As, 500 ppm Cu, 50 ppm Sn, and 15 ppm Pb and Sb.

The total inclusion count must be very low: after a 40-field count performed according to the ASTM E45D method, the weighted sum A+B+C+D must be lower than 20, with limit index values for each type being 1 or 1.5.

And finally, the magnetoscopic property evaluated according to the Air0819 standard, must fulfill class 4 criteria.

At Pamiers, this level of quality was obtained (with, in addition, a sulfur content lower than 20 ppm, and inclusions smaller than 12 microns, all of them of type D) by acting simultaneously on the conditions of the mother run and the remelting parameters. The remelt rate is automatically controlled by a computer which takes into account the current, voltage, instantaneous weight of the electrode, and so on, resulting in a perfectly reproducible process and guaranteeing a regular solidification. The choice of slag also plays an important role, as does the control of its humidity and that of the atmosphere, so as to avoid any hydrogen recapture.

While the THQ steels represent the top of the line, those at the QAS level provide a broad range of possibilities for other safety parts, despite a slight reduction in performance and maximum specifications. The maximum size of inclusions is 15 microns, and the weighted sum for the ASTM E45D method must be less than 35.

ESR-QAS remelting is thus a means for protecting against the random or accidental presence of critical size inclusions, due for instance to entrainment of refractory materials, whose absence cannot be quaranteed by any arc furnace fabrication, no matter how advanced. The ESR-QAS quality was used to make the construction components of the engine support pylon for the Airbus, using 40 CDV 12 steel: the ribs under a 65,000 kg hammer, the lower spar with the interforge press, and the lateral 14-mm thick plates, in the Creusot mill.

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BILLION: EUROPEAN LEADER IN PLASTICS-PROCESSING EQUIPMENT

Paris INDUSTRIES & TECHNIQUES in French 20 Feb 82 pp 23-25

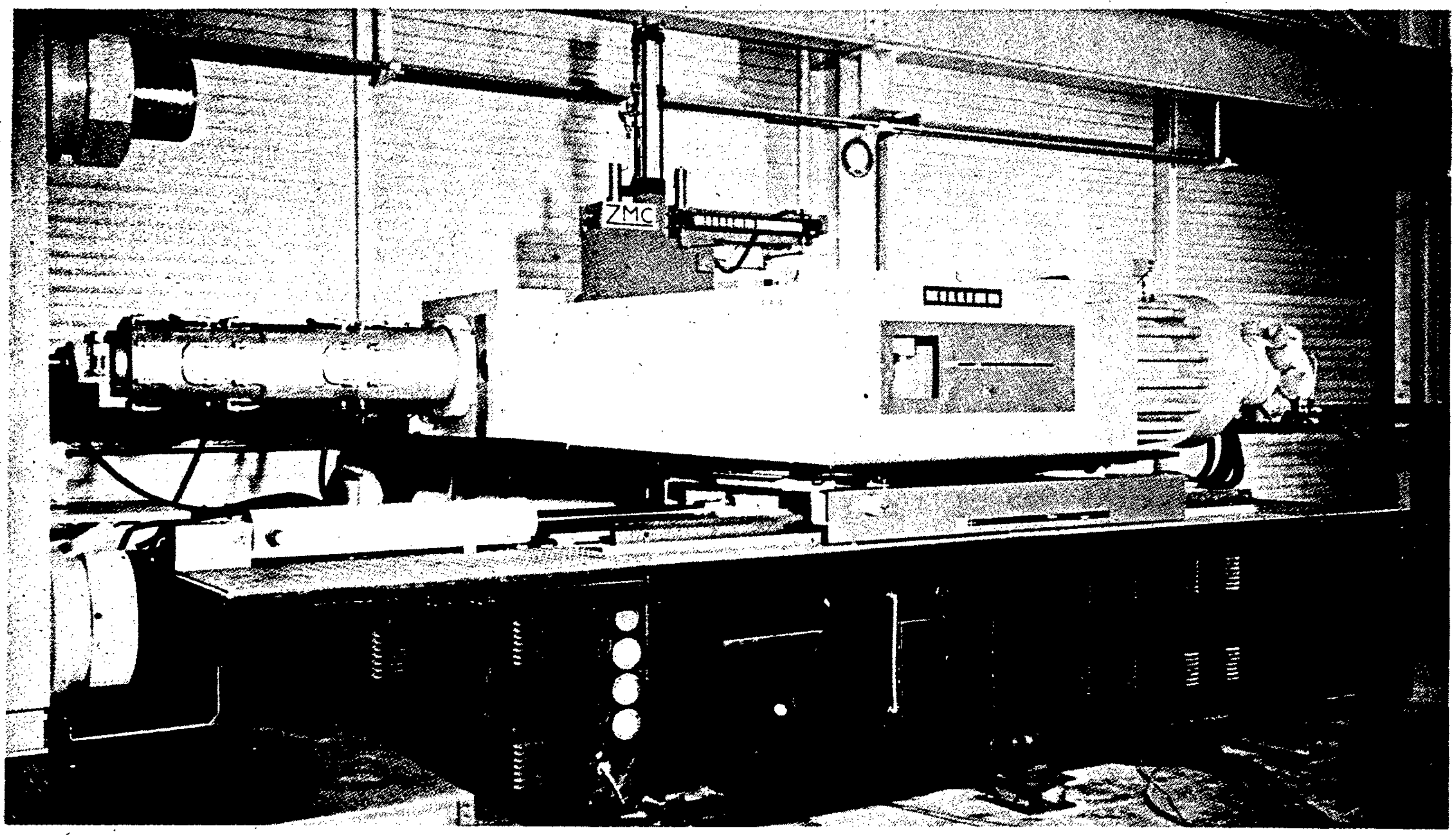
[Article by Christian Guyard]

[Text] Doubled production capability and modular design: Billion's aim is to be in first place as European builder of injection presses. From 90 t to 10,000 t, integrated hydraulics and adapted automation.

"Whether the part weighs two grams or 170 kg, we have a machine capable of fabricating it. Our business is the injection of plastic materials: thermoplastics, thermosetters, reinforced or not. We know how to process." Jean Laurent, director of SMTP Billion is quite self-assured. It is true that for the past 15 years this enterprise has been a pioneer in the automation of injection presses, and that it intends to continue to be among the leading European and world builders of such machinery. To justify this ambition and reinforce its position on the international market, Billion has just gathered all its production resources at the Bellignat location, near Oyonnax. Production capacity has just gone from 300 to 600 machines per year, and expansions are planned to bring it to 1000 units per year. The new plant was built in no more than six months: when you belong to the Saint-Gobain Pont-a-Mousson group, everything is possible. Thanks to this, for instance, it carried out the study and construction of a 10,000 t press.

But Billion also sought to avoid sterilizing its creativity when it became a subsidiary: the Billion autonomy and spirit still exist; its research policy and its--at times original--means of production testify to that. This uninterrupted research explains the perfect match of machines to users' needs (modular line), the solving of such difficult problems as the 10,000 t press (25,000 hours of design), and the development of the Visumat and Ordimat systems, as well as the ZMC process. The latter is a revolution in the injection of thermohardeners reinforced with long glass-fibers (25 mm and more).

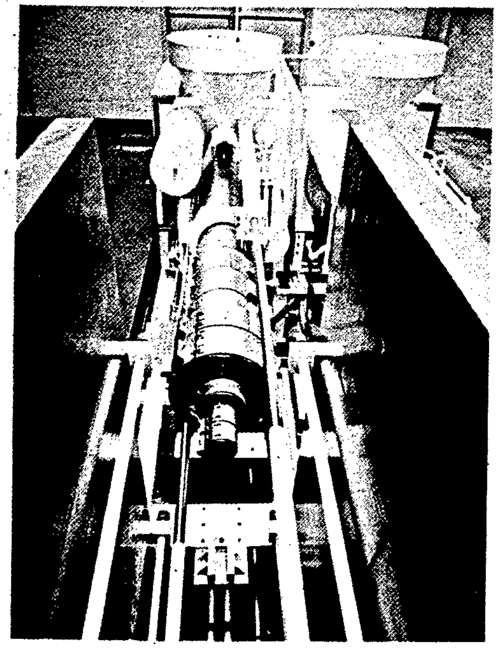
The process responded to the needs of automobile manufacturers, who are forced to reduce weight by substituting plastics for metals. But the automobile industry makes stringent demands on production rates, appearance of parts, and painting. The approach that met the production rate and price demands was injection. As Jean Laurent points out, "ZMC is not merely a logo. It is first of all, and unlike the other processes, a brand name. It is also a resin which withstands the drying conditions for conventional paints (3 h at 180 degrees C), a patented machine, and



The ZMC process revolutionizes the injection of thermohardeners with long glass fibers. It fully meets the specifications of the automotive industry: mechanical properties, drying conditions, rate, price. (Documents Billion).

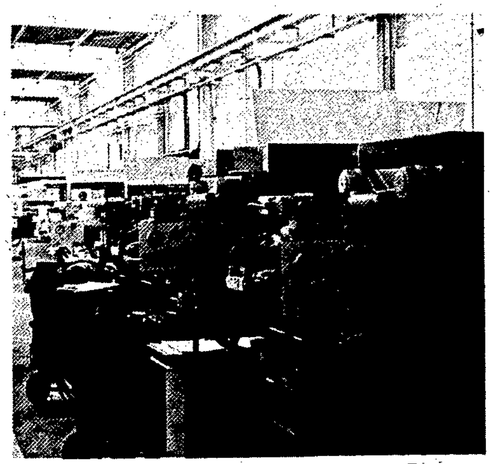
of course, a mold guaranteeing the quality of the fabricated parts." While Billion is the builder of the system, its collaborators have come from many areas: Vetrotex for the glass fibers, Air Industrie for painting problems, and so on. Today, the process is perfected, and two machines of 2500 t and 140 t are under development. But the process is also compatible with all the other presses of the company. Car body parts are currently being tested, and several French mass production models should soon be built with them.

Compared to conventional injection machines, the ZMC has original features which avoid any fiber degradation. The loading hopper is equipped with a pusher system which feeds the screw and assures a constant rate of plastification. The material is introduced in the form of SMC, BMC (shreds), or direct incorporation of the load in the machine. The screw is mounted inside a sleeve which retracts with it, thus defining the volume of materials to be injected. Injection occurs through advance of the screw-sleeve assembly, at rigorously controlled speeds and pressures. The flow rate can thus change from 0.1 to 2 l/sec in a single cycle. Any backflow of the materials in the screw is impossible, even though the injection pressure reaches 800 bars, a value which is essential for a good surface finish. For specific parts,



The frame design changes the concept of high capacity machines.

Individual storage of parts: 10 tons, 7-meters high, 50,000 computer listed items.



Manufacturing lead time for a machine will soon go from eight to seven months.

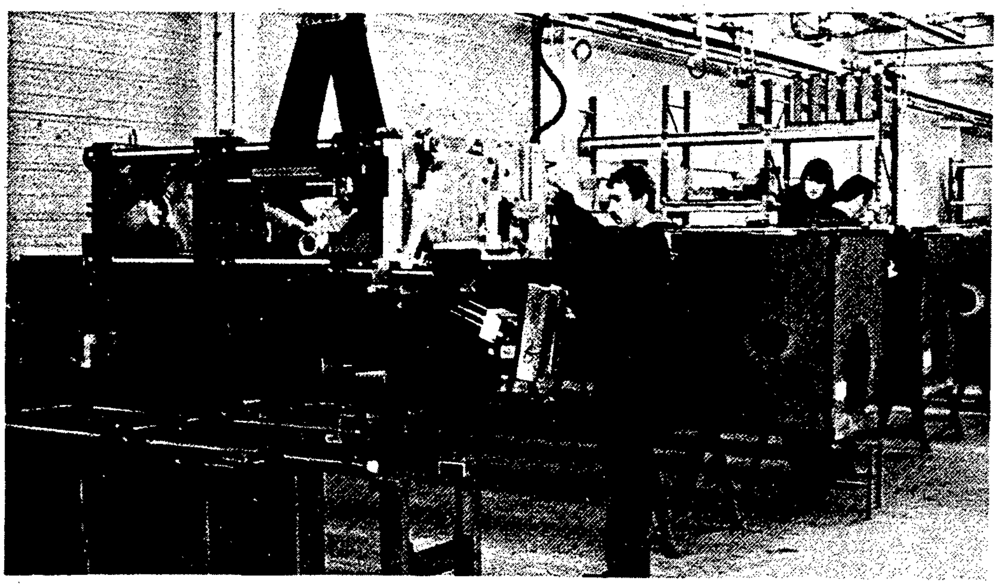
however, the machine can perform in injection compression. The materials are introduced into an incompletely closed mold, where they penetrate more easily. The fibers are handled in the same way as the mold zones that are sensitive to abrasion. When the mold is filled, the shut-off is complete and high pressure is assured. The mold temperature reaches 200 degrees C, thus requiring mechanical extraction. The extractor, as well as other peripheral devices, are controlled by the Visumat system.

Electrical panels and cabling are pre-assembled and tested before final assembly.

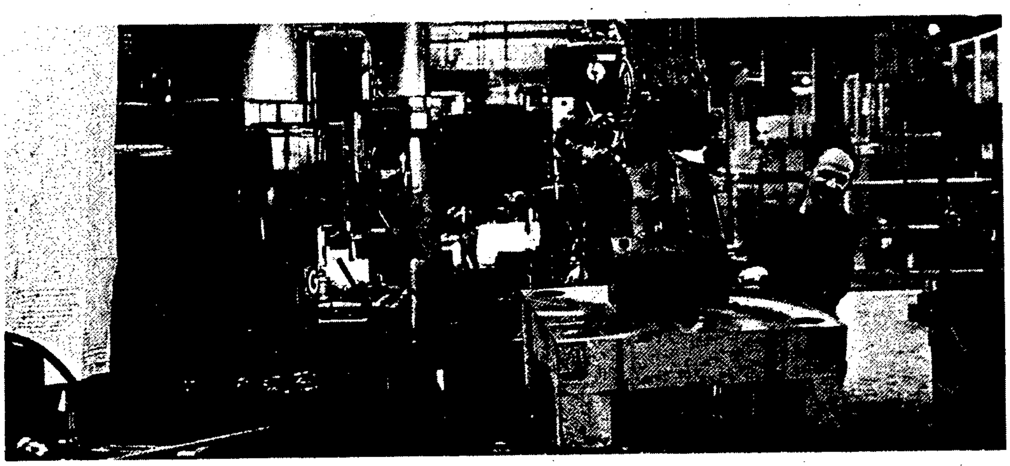
Integrated hydraulics, pressure accumulators: time-tested solutions.

Another innovation, and not the least of them, is the 10,000 t pressure press. Its origin is connected with the problem of a customer, who wanted a machine with minimum platen flexing. The conventional column system led to extraordinary thicknesses of mold-mounting platens, since the stress is supported very locally: this led to the idea of distributing it over the entire width. The result was a evolutionary design, very original solutions, and 500-mm thick platens, which is three times less than for the column system. A computer was used to design the structural elements. The project was firmly handled, requiring only one year between the decision to build and the completion of the assembly. Eight frames of increasing thickness surround the platens. The clamping mechanism uses the Billion technique of mechanical jamming and hydraulic locking, which is provided by eight 1250 t rams. The mold guidance function is assured independently of the pressure by machine-tool type slides located above and below. The molds, whose thickness ranges from 1.90 to 2.40 m, are installed by rolling on one side and lifting with hydraulic rams. The heavy-weight bridge is thus eliminated. The parts are also removed laterally. For injection, this 30 m-long monster accepts up to three different units, making it possible to simultaneously produce several parts or one multi-material one. Operating so far are only two machines of 10,000 t and 5000 t. But the system is promising, since a feasibility study for a 50,000 t machine has already been completed.

In this pursuit of hugeness, the company executives are not forgetting that machines of less than 300 t represent 90 percent of the world market. This has led them to rationalize production and offer a new modular line which covers all the equipment from 50 to 10,000 t. Thanks to this and with a minimum investment, the user has access to sophisticated tooling and highly diversified materials. Three injection units and four platen dimensions are available for each pressure. The assemblies reflect the separation of the line into two ranges, 50 to 450 t, and greater than

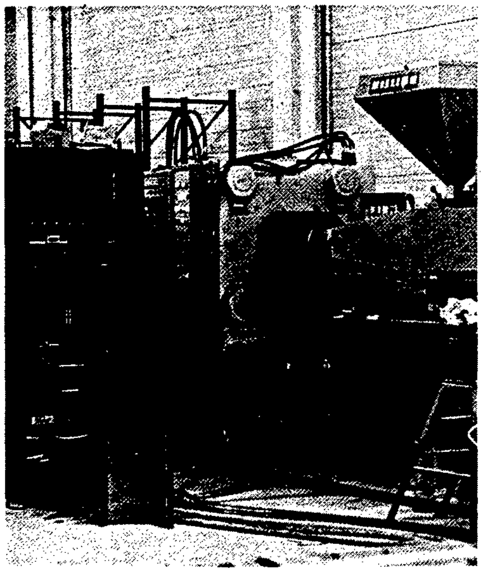


The modular line consists of subassemblies. One machine can receive various injection units and four platen dimensions.



The majority of parts are machined on numerical control machines. Threads are cut on in-house machines.

650 t. The equipment is built from subassemblies which are put together on two parallel lines. The mechanical, hydraulic, and automation portions are prepared separately. After mounting on standard frames and painting, the equipment is moved to final cabling and testing. The machines are received by customers at the plant; they require 8-9 months for construction. This will be reduced to seven months when supply logistics will be entirely computerized. The plant presently produces 30 units per month.



After assembly, the machines are received by customers at the plant.

In the research department, the next ten years are being planned in secret.

Subcontracting is important. The sheet-metal department is almost eliminated, and all thermal treatments are performed on the outside. On the other hand, the machine shop plays a primordial role: it produces the screws, sleeves, rod bearings, and injection heads. The latter, made of GS cast iron, are particularly important because they form the bored block for the integrated hydraulics. The screws, with diameters of up to 200 mm and lengths of 4 m, are machined in-house. Higher dimensions are handled by the SMTP plant of le Havre. Depending on complexity, 3-10 passes are necessary for completion on machines designed at Billion. The sleeves are bored from bars; the boring length is about 25 diameters. Some sleeves are bimetal, with a hard inside case, which gives them a long lifetime. The heaviest parts are the platens, which are made of forged steel. The largest borer (a platen can have as many as 180 holes) can work over an area of 2.5 m by 5 m. The machines are French and are generally numerically controllled.

The automation shop, which has some 50 employees, produces the electrical equipment. To save time, the bundles of cables (spiders) are prepared on boards specific to each machine: one for the injection, the other for the closing. The various electronic circuit boards, designed by Billion, are essentially subcontracted. Once assembled, the racks are bench tested by simulating the machine's functions with small pneumatic rams. This test is recorded and kept until the machine is received. Machines larger than 650 t have Visumat as standard equipment. This is a system whose success is unquestionable: more than half of the customers request it when offered as an option on the smaller presses. All parts, except the very large ones, move through a storage warehouse, where 50,000 items are managed by a computer. Parts or subassemblies are stored at the plant, on seven levels of pallets: 10 t stacks, 7 meters high.

This production organization is based on two key services: the mechanical and hydraulic design department, and the center for applied testing and research. The design department, which will soon be equipped with CAD, has 25 employees. The hydraulics aspect is primordial, because there would be little use for electronic speed if the hydraulic rams cannot follow it. Integrated accumulators and hydraulics are conventional.

The testing center is part of Billion. To manufacture a part means to assemble a processor, a mold, and a material. Delicate technical problems are solved in this shop. At the research center, discretion reigns above all. That is where today's successes were once developed. New automatic devices are being studied at present, and the only certainty is that the plans must be made for the next ten years.

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FIRST ROBOT MACHINING CELL FOR SMALL FRENCH FIRM

Paris INDUSTRIES & TECHNIQUES in French 1 Mar 82 pp 25-27

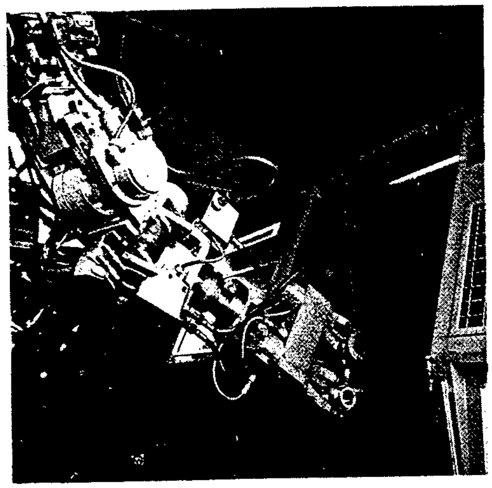
[Article by Andre Larane]

[Text] Robots work and they are profitable. Sahl Leduc proves it with a turning and milling machining cell. As simple as a machine-tool, robots nevertheless require a lot of skills.

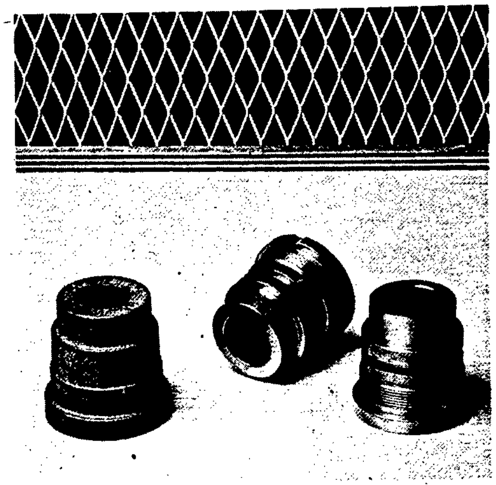
In 1976 the Sahl Leduc company, a PME (small and medium-size enterprise) with 80 employees specializing in the fabrication of hydraulic jacks, received its first numerical control (NC) lathe. In 1981, with 180 employees by this time, the company, in Niort-sur-Erdre, Loire-Atlantique, has 12 NC machines and a robot machining cell for turning, the first one installed in a French PME. Although numerical control has improved the hiring situation, the purpose of this robot and of those which will soon arrive, is primarily to improve quality, costs, and productivity, while raising the level of responsibility of workers. "Investing in robotics is to comply painlessly with the regulated work hour reductions," points out Joel Leduc, manager of the enterprise.

This observation is current and has no futuristic overtones. For almost six months, the articulated arm has been servicing seven work stations with clockwork regularity. Occasional breakdowns of microelectronic components have nothing in common with the problems experienced by some industrial groups that have engaged in similar adventures. Quite honestly, we must admit that at the time of our visit, the only problem encountered was associated with some program sequences in the control unit detached from the machine, which made it necessary for the supervisor to temporarily return to manual sample control.

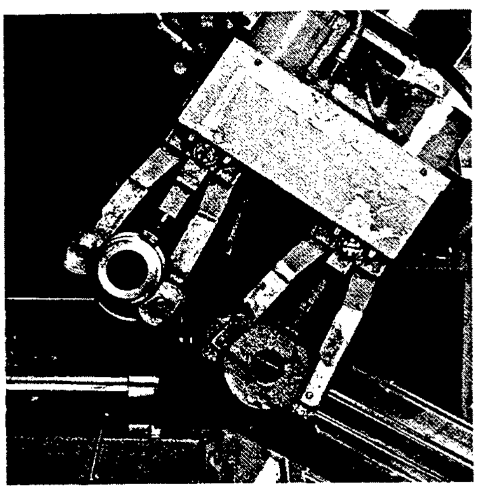
This drawback is largely compensated by the operation of the installation during two shifts (including breaks), namely a full 16 hours. Eventually, it will machine 21 hours a day, and if the work load demands it, will be able to also work during holidays without major handicap for the personnel. Only one attendant is needed for monitoring, loading rough parts, and small adjustments. Formerly, one full-time operator was needed for each of the two HES Transnum NC lathes, while two part-time workers took turns on the milling-boring machine and control. The total manpower gain is nearly 75 percent! The workers have therefore moved toward other sectors of the shop, or toward the methods department.



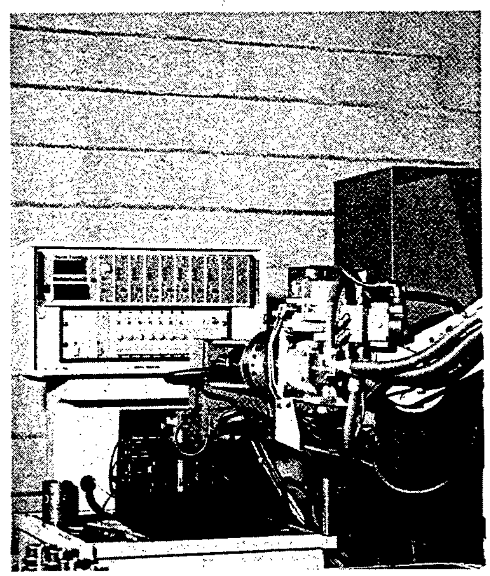
An NC lathe is part of the cell.
A piston grasps the part.



Seven stations for turning, milling, and quality control of the rings.

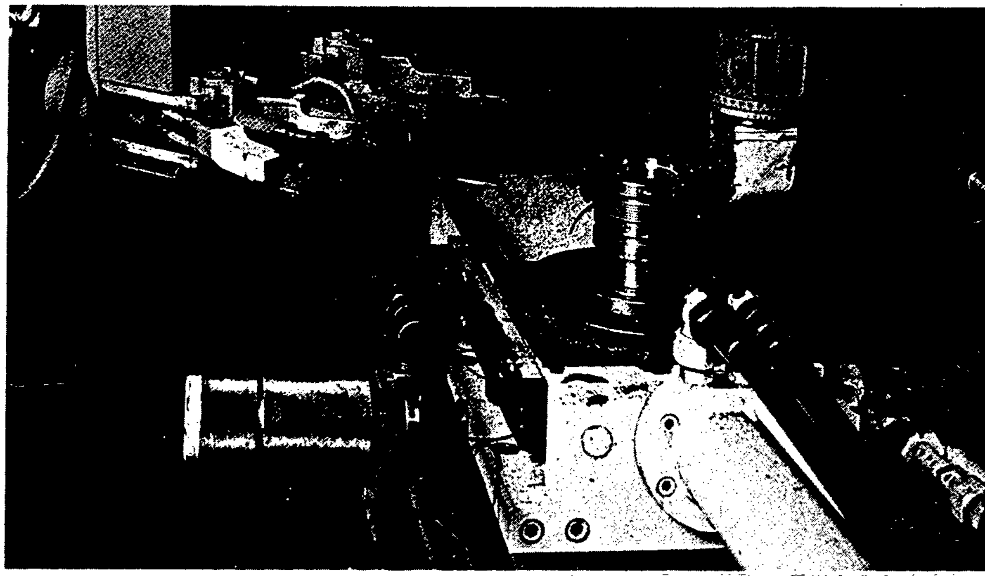


A hand for two parts: loading the rough part, and removing the finished one.

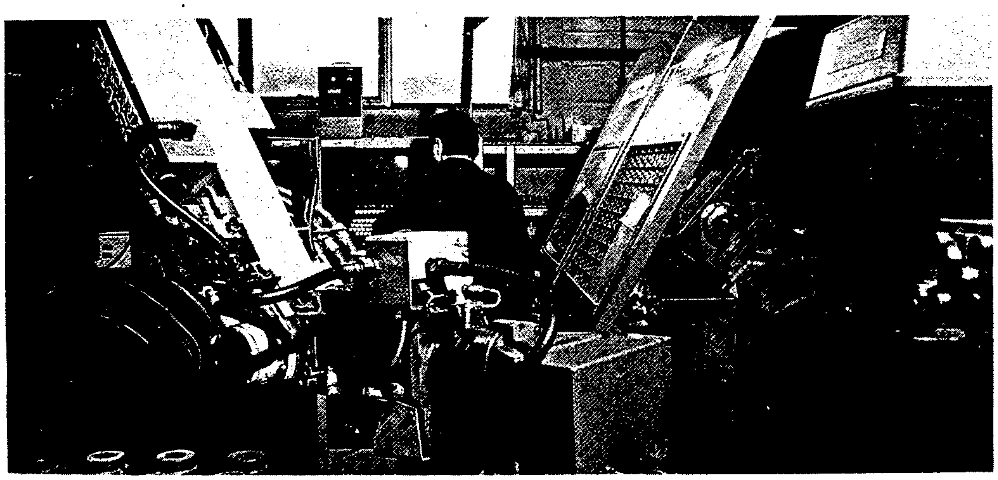


Electronic control and analysis of measurements for tool correction.

The pace of the work is impressive: the cell produces 20 parts per hour, compared to 15-17 with CN. Quality is improved thanks to unified control, which will eventually be complemented with the printing of a certificate of conformity. Once the robotized assembly is available, this procedure is no more difficult to implement than an ordinary sampling quality control.

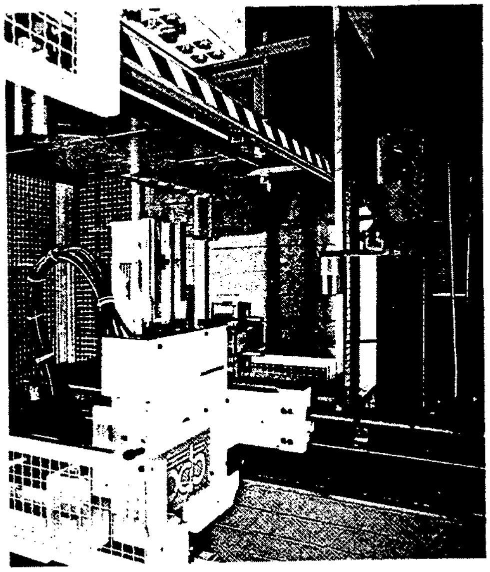


After turning, the part is brought to a small milling station by an automatic platform. Since the operation is very brief, the robots waits at this location.

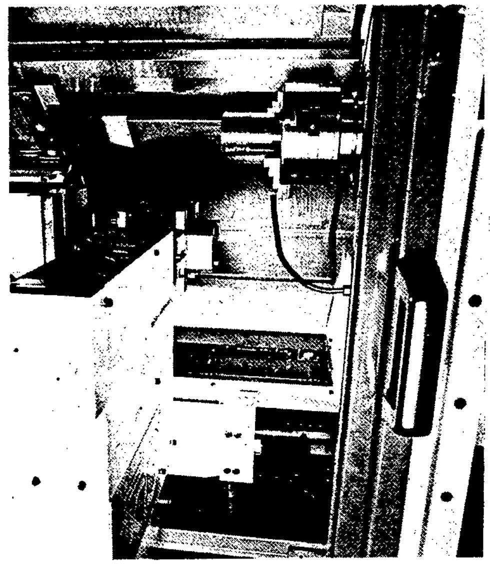


Supervision of the robot requires technicians, and a knowledge of mechanics, electronics, and computers. The majority still lack this training.

The Sahl Leduc (Societe d'Applications Hydrauliques Leduc) cell is designed for a family of guide rings weighing about one kilogram, with a diameter of 50-100 mm. These are short shapes of revolution, of rather high precision (on the order of a hundredth of a millimeter), threaded, bored, and grooved. Rough parts are picked up from the palletization station by the hand of a Cincinnati T3 robot. The latter is capable of handling a 45-kg part along six degrees of freedom and 240 degrees of circumference, maintaining a positioning accuracy of 0.5 mm even at 2.40 m from the central pivot.



Lathe with integrated robot. A cell alternative for simple parts.



The robot's value depends on its autonomy and storage capacity.

The part is brought successively to the two lathes, and is carried by one of the robot's hands. The other hand removes the finished part from the lathe. Each is cut and finished on the outside, on the throat and the bores, then threaded. Afterwards, it is sent to the milling machine and two chip blowing stations. It is essential that the part be absolutely clean before reaching the automatic gauge. Six to eight dimensions are measured with several electronic sensors. If the dimensions are out of tolerance--"which occurs much less than once in one hundred," according to Christian Leduc, head of manufacturing--the robot places the part on the ground; otherwise, it places it on the outgoing pallet.

But the control machine also serves to detect tool wear, based on dimension variations. It transmits its analysis to the lathe's computer, which then corrects its program so as to compensate for the tool length variation.

One machining cycle uses four tools per lathe; and since each lathe has a head with eight tool positions, it also has four spare tools, allowing it to be autonomous for ten hours. Two pallets of 100 rings can be completed during this time, after which the operators change the carbide-tipped tools.

Should a tool break during machining, a current loop located on the spindle detects an excessive effort; this signal stops the operation.

Christian Leduc was won over at EMO 81 in Hanover, by tool head magazines which change tools during idle time. But he sees no need to introduce them in his shop. First, because his older H. Ernault Somua lathes would accept them poorly, and secondly, because the 20 minutes needed for the manual operation are not significant compared to the ten hours of uninterrupted machining.

Parts loading and unloading, on the other hand, occurs during idle time thanks to four pallets (two for the rough parts, and two for the finished ones). The rough parts are accurately positioned by retractable fingers; the arm has no difficulty in finding and grabbing them.

With its cooling devices, its seven work stations, and the palletization for 400 parts, the robot covers 50 square-meters. This compactness and the perfect synergy of the whole are the pride of Christian Leduc. "By itself, the robot is only an articulated mechanical arm, a machine-tool like any other," he comments. "We had to surround it with heterogeneous elements." Among these, the two H. Ernault Somua lathes, each worth about 550,000 francs, predated the formation of the cell. The control machine was bought abroad. Including the 520,000 francs for the arm, the total cost of the cell amounts to nearly two million francs without the initial adjustments.

A Cincinnati engineer, for whom this was a test installation but who was no less enthusiastic for it, collaborated in the connection of the test stations to the central computer. For the rest, Christian Leduc and his colleagues worked almost alone.

"Thanks to the experience that I gained, I will need only two weeks instead of eight months to install the next cell," he assures us. "It's not much more complicated than any other installation, as long as you have a rather good knowledge of electronics and computers, and especially, as long as you solve the many problems of mechanical implementation and adaptation. The turn-key robot does not exist." For instance, in this installation a part is clamped on a lathe by means of an auxiliary ram whose thrust is controlled by the computer. In another location, a hydraulic platform for part placement is adapted to the milling machine. The interface between the central computer and the various cables were installed by the electronics specialist of Sahl Leduc.

In addition to the palletization station, the greatest difficulties were probably created by batch changes. Christian Leduc designed adaptable clamps such that the arm's memory remembers the position of parts on the pallet independently of their shapes and dimensions. This minimizes adjustments and reprogramming, and encourages the use of the cell for repetitive intermediate size runs. Despite this precaution, the transition from one product to another still requires nearly three hours for two workers, and the manufacturer avoids making more than one change per week.

To start, the user first programs the motion on a learning mockup. A maximum of 1200 points are recorded in a file in the central computer which guides the robot. Point corrections are subsequently performed by introducing numerical coordinates. The displacement speed between two stations can be programmed at will from 0-1.2 meters per second. Each machining program is then memorized in the lathes' NC computer, which communicates with the central computer; the latter determines the start of programs, as well as controls specific automatic operations, such as blowing or palletization. In case of local breakdown, as for instance the opening of doors on a lathe, the central computer receives the information from the NC computer and stops the operation. Should the handler itself become defective, the manufacturer has the option of disconnecting the lathes and operating them with attendants. But this has not yet happened.

Christian Leduc's experience encourages him to make further investments. An SMT-Pullmax lathe with automatic loading integrated in the machine has been operating since January 1982. Like the robotized cell, it works alone, but on parts that do not have to change orientation, such as hydraulic ram rods. In September, the company will acquire an FLS lathe from H. Ernault Somua, with an auxiliary milling station, tool-head magazines, part sensing, and total flexibility. And finally, the second robotized cell for machining the rear portion of hydraulic jacks is planned for 1983. Its location is already reserved near the first. One supervisor will attend both. Three workers are preparing for this task. They have to be good adjusters, have some knowledge of computers and electronics, and demonstrate initiative. This is the price to pay for moving from a simple NC lathe to the supervision of a flexible shop. It is surprising that several young workers who have been asked to take the step are hesitating. And yet that is where their future lies.

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RESEARCH ON HIGH PERFORMANCE CERAMIC MATERIALS

Duesseldorf VDI NACHRICHTEN in German 2 Apr 82 p 13

[Article:"Ceramics as Design Materials"]

[Text] Recently a materials colloquium with the theme "Ceramics as a Design Material" was held in Cologne-Porz. The papers and a poster exhibit focused on the material silicon nitride. The work of the Institute for Materials Research in the area of development and characterization of Si_3N_4 and the development of characterization methods for high-temperature-resistant ceramic materials was reported.

Within the scope of research focused on energy and propulsion technology, the German Research and Testing Agency for Aeronautics and Astronautics (DFVLR) has been involved with the development of ceramic materials for high stresses and temperatures since 1975. The objective of this work is to advance the development of alternative, more economical vehicle propulsion systems from which energy savings can be expected from the higher efficiency resulting from higher working temperatures. Working temperatures greater than 1,000°C are, however, only to be achieved by using ceramic materials.

Based on a combination of favorable properties such as low density, low thermal expansion, good oxidation and corrosion resistance and constant strength up to temperatures beyond 1,200°C, silicon nitride (Si_3N_4), alongside silicon carbide (SiC), is considered to be the most promising material for withstanding high stresses. Thus, these materials are of interest for applications other than vehicle power plants alone. Standing in the foreground as an ambitious objective supported by the Federal Ministry for Research and Technology (BMFT) is the development of an automotive gas turbine based on ceramic components. The work of the Institute for Materials Research is focused on this goal. In addition to material development and properties optimization, activities are concentrated on the determination of properties and their correlation with material structure plus the development of new characterization methods.

Molded parts made of silicon nitride can be produced by various methods which fundamentally affect the material properties. Two classical methods for producing molded Si_3N_4 parts are reaction sintering (RBSN) and hot press forming (HPSN). In reaction sintering, a mold filled with silicon powder is heated to temperatures between 1,200 and 1,420°C in an atmosphere consisting primarily

of nitrogen. The resulting reaction converts the silicon into silicon nitride. The big advantage of this method is that the external dimensions of the molded part do not change. In this manner parts with complex shapes can be formed without difficulty. A disadvantage is the relatively low strength of RBSN parts due to residual porosity resulting from the process. However, the room temperature strength is retained almost up to 1,400°C.

Since due to the predominantly covalent character of the Si_3N_4 bond powder parts cannot be consolidated by sintering alone, the hot press method was for a long time the only method by which almost fully dense, high strength Si_3N_4 parts could be achieved. This method requires, however, the addition of suitable agents which foster the compacting process at high temperatures by the formation of a molten phase. These additives, which in general are retained in the material in the form of an amorphous particle boundary phase, cause a loss of strength due to softening at temperatures above 1,000°C. An additional serious disadvantage of the hot press method is that the actual parts have to be ground or machined from the simple geometric shapes--disks, plates--which are the only shapes producible by HPSN.

This disadvantage should be eliminated by the process of sintering and hot isostatic pressing which has been under development for several years since by this method powder parts with complex shapes can be consolidated with due allowance for the resulting shrinkage. Direct sintering (SSN) was made possible by further development of the Si_3N_4 starting powder. In this process, the properties of the sintered part exhibit a specific dependence on the Si_3N_4 starting powder and on the type and quantity of the sintering agent. The effect of these factors and various process parameters on sintering density, structural development, bending strength and fracture resistance were presented. Representative of the state of the art is an SSN part which, with the addition of a mixture of Y_2O_3 and A_2O_3, can be sintered to 96 percent of full density without pressure and which exhibits a room temperature strength of about 600 N mm^{-2}.

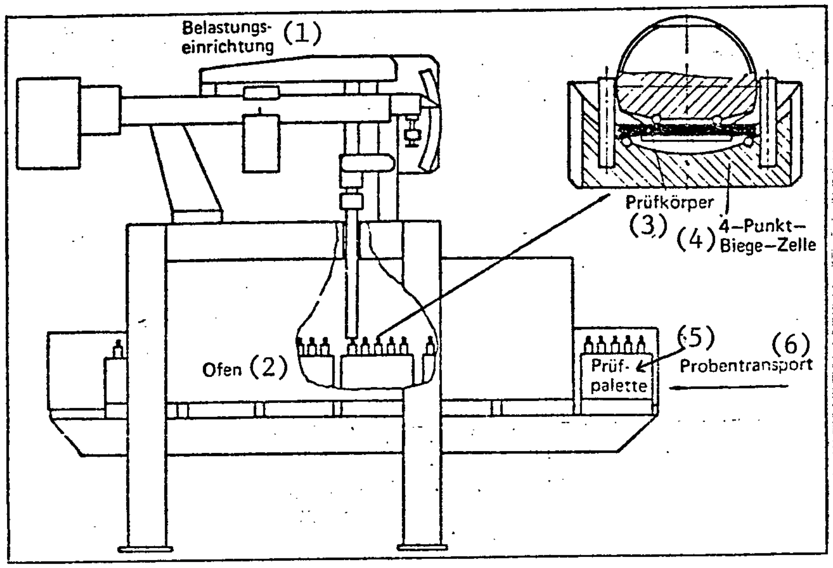
Recently the postsintering (SRBSN) of RBSN has been pursued as an alternative sintering method for producing dense, high-strength Si_3N_4 and for improving the properties of RBSN. Economic advantages were expected from this process. The increase in the number of process steps implies, however, an increase in the influence factors which must be researched.

Hot isostatic pressing (HIPSN) represents a method for producing complex molded parts with HPSN quality which practically eliminates the expensive postworking operation. Progress in HIPing Si_3N_4 was reported with detailed discussion of the problems associated with gas-tight encapsulation, or canning, of porous preforms. Either metal or glass cans can be used. Advantages for universal application are expected from glass cans. This has been demonstrated for simple molded parts, but further development work is necessary for complex shapes. The material quality achieved already surpasses HPSN qualities with regard to isotropy. Tests of canless post HIPing of SSN parts have just started.

In addition to the technology, the papers and posters treated as an additional center of interest the determination of use-related material properties. Since

Process	Reaction Sintering	Hot Pressing	Sintering	Post Sintering	Hot Isostatic Pressing
Short Designation	RBSN	HPSN	SSN	SRBSN	HIPSN
Starting Material	Silicon powder	Silicon nitride powder + additives	Silicon nitride powder + additives	silicon powder + additives	silicon nitride powder preforms + additives
Process steps	shaping nitriding $\leq$ 1420 Deg C $\geq$72 h end product	hot pressing $\geq$1750 deg C $\geq$1 h ~30 N mm^{-2} fabrication from molded billet	shaping $\xrightarrow{HIP}$ sintering $\geq$1750 deg C $\geq$1 h $\xrightarrow{HIP}$ end product	shaping nitriding $\leq$ 1420 deg C $\geq$72 h $\xrightarrow{HIP}$ sintering $\geq$1750 deg C $\geq$1 h end product	→ RBSN preforms + additives → SSN preforms with porosity $\geq$5 % / SSN preforms with porosity <5 % canning hot isostatic pressing $\geq$1750 deg C, $\geq$1 h 2000 bar gas pressure end product
Process characteristics:					
Shrinkage %	none	./	< 15	< 5	variable
Postworking	none	very expensive	little to none	little to none	little to none
Residual porosity %:	>20	very low	low	low	very low
Bending strength N mm^{-2}	~300 (RT-1400 deg C)	>700 (RT-1000 deg C)	>600 (RT-1000 deg C)	>450 (RT-1000 deg C)	700 (RT-1000 degC)

The tabular summary of the processes for producing molded silicon nitride parts permits a comparison of achievable properties and process characteristics.



The hot bending test machine for continuous operation can be operated in air up to 1,600°C.

Key:

(1) Loading machine
(2) Oven
(3) Test sample
(4) Four-point bending cell
(5) Test-sample tray
(6) Tray conveyor

the loading intensity is not comparable to that of conventional ceramic materials, the test equipment had to be largely designed and built for the new materials. Examples of this are the hot bending test machines for continuous operation as well as the tensile- and creep-test machines. These machines can operate in air up to 1,600°C. RBSN has proven to be well suited as a material for the specimen grip head.

The behavior of the materials in continuous operation is also of interest. This information is acquired through thermal shock and thermal fatigue testing. The room-temperature strength curve determined by the thermal-stress amplitude--room temperature to 1,260°C--versus the number of cycles to failure shows the great importance of this test method for practical applications. Microstructural and microanalytical research methods such as Auger and photoelectronic spectroscopy should illuminate the processes which lead to this material behavior so that they can be controlled during material development. Also, a method for predicting the life of ceramic materials by dynamic 4-point bending tests was presented. This process will be further developed for predicting the failure probability of HPSN at high temperatures.

This overview of the production and test technology for ceramic design materials reveals the necessity for further research work. The large number of participants from the most varied branches of industry reflects, on the other hand, the broad interest in highly stressed ceramic materials and components for purposes such as the development of energy saving automotive power plants.

9160
CSO: 3102/267

HOFFMANN SEES FUTURE FOR WOOD-COMPOSITE PROPELLERS

Gelsenkirchen AEROKURIER in German Apr 82 pp 402-406

[Article entitled: "Hoffmann Propellers: With Know-how and Experience in the Service of Progress. Wood-Composite Propellers Have a Future"]

[Text] It is way at the front of the airplane, yet for the most part it is treated in a very unkind way and frequently is given little attention: the propeller. Yet, in many ways the propeller is of decisive significance for the characteristics of an airplane, from overall flight performance to noise development.

That which in pilot jargon is often somewhat disrespectfully called a "slat," is in reality a very complex thing which involves a great deal of aerodynamic, material-technical, flight-mechanical and vibration-technical know-how before it exercises, to the satisfaction of the technologists and pilots, its propelling service on the airplane in an effective, safe and environmentally positive way. Throughout the world there are now only a few companies which have a name in propeller building. Although after the war in Germany things did not work out so well with the development of its own light aircraft industry, Hoffmann Propeller has managed, in a technological respect, to take a leading position in propeller building today, not last because it made a continuous effort to develop and realize its own ideas for solving problems.

Propellers, only propellers, were in the mind of the founder of the company when in 1955 he laid the foundation with great confidence in the upward development of aviation.

Initially, fixed wooden propellers were built in the "Schwarz" tradition and early on an electric variable-pitch propeller was developed and type tested. But the German aircraft industry did not enjoy brisk development such that a company could have stayed alive solely from manufacturing propellers. Thus, servicing foreign products, which did in fact dominate the postwar market, was also taken on and the stock of spare parts--essential for efficient service--was consistently expanded. Thus, connections with all respected propeller manufacturers go back to this period in the late 1950's. Today there are contractual commitments with these international companies, and the special spare parts stock for propellers and parts is the largest in Europe.

The picture of activity at Hoffmann Propeller has, nevertheless, again developed to an increased degree in the direction of manufacturing again. And in the past few years in Rosenheim it paid off that, with the appearance of new technologies, the people there were also simultaneously learning.

While Hoffmann had always emphasized the natural fibrous material wood as an excellent material for propellers because of its great tearing length and its vibration-damping material properties, today the development of propellers--as could be foreseen--is moving away from the heavy vibration-stressed metal propeller to light composite construction materials.

The larger the diameter of the propeller, the greater also the advantages of present-day construction methods in respect to weight and saving weight, respectively, and also moments of inertia. Thus, it is no longer surprising that the propellers of the new commuter generation, which will be used starting in 1984 with new turboengines roughly between 900 and 1,500 kW, will be built almost exclusively with composite blades.

The development of such propellers, controling the diverse strength problems with new material structures are protracted and cost-intensive undertakings which can be handled only by large companies, and then only for the most part with state support.

The results, propeller blades made of fiber-reinforced plastics with or without supporting metal parts, are likewise expensive, because expensive facilities are required in turn to manufacture them. Their advantages in respect to the conventional metal blade are--according to the people at Hoffmann--on the whole not greater than with the wood-composite blade which is being further developed here.

Why, then, might one ask, is the wood-composite blade not in use worldwide? There are several reasons. The large propeller manufacturers naturally have their own development lines and feel a certain aversion to the material which is unfamiliar to them, which they really do not know how to handle properly and which requires totally different material-specific manufacturing facilities.

The aversion, however, likewise stems from bad experiences with wooden propellers which go back to the 1920's and 1930's.

In the United States development of wooden propellers stopped at this level so that the metal propeller, in spite of the greater weight, was able to set forth unhindered on its victorious march. However, in Germany, and especially at the Schwarz Co in Berlin-Waidmannslust, development was consistently continued in the 1930's: wood is susceptible to the influence of the weather. If it is to be used as a load-bearing material then it must be protected from environmental influences. For example, holes must not be drilled, as for example to attach edge fittings, which rain water can then penetrate. In the case of single blades, which must be attached so that they can rotate in a control hub, special attention must be paid to these components.

For this purpose Schwarz used resin-bonded densified laminated wood which was made from thin layers of veneer; it weighs only about half as much as duralumin, but achieves the latter's tensile strength when greatly stressed. Patents for erosion protection without screws and rivets, protective and reinforcing covering of the wood core and details of application for resin-bonded densified laminated wood were everywhere.

In the United States, of course, such improved wood was never used in propeller construction.

Development took a different course during the war in Europe. The fastest airplanes used wooden propellers which also disproved the alleged inferiority of this material for use in designs of especially high efficiency.

The FW 190, for example, had wooden propellers as did, for example, the Spitfire in England. In general, toward the end of World War II, about 90 percent of German airplanes were equipped with wooden propellers. The reason: on the bombed out airfields a short takeoff was important. For thrust augmentation wider blades were needed. These could no longer be made of metal because weights and control forces would have become too great.

The development of the wood-composite propeller, which goes back some time, underwent carefully controlled further development at Hoffmann's in Rosenheim. This is not a chance happening because the advanced technical school for wood and plastics technology is located there and was the training site of several staff workers of the technical staff and the firm's management. The relationship is still close today, and strict controlled development tasks are implemented with consultation and support of the advanced technical school.

At Hoffmann's there is the view that this purposeful adhering to a construction method which is recognized as valid is paying off today. While years ago propeller overhauling was a basic branch of business, today the company's income comes from many spheres of activity, all however characterized by appropriate engineering knowledge, but in part also outside aviation. Thus, the production program at Hoffmann today is very diverse:

--Fixed and adjustable propellers are built, involving--as needed--the most recent findings in respect to noise reduction.

--Thanks to the increasing activity by airplane manufacturers in the FRG and in several other countries variable-pitch propellers for motor-powered gliders are gaining increasing importance.

--Automobiles are tested aerodynamically in wind tunnels; the fan blades were produced by Hoffmann using the tested wood-composite construction method. Similar installations are in use--to mention but a few--at Ford in Cologne, British Leyland in England and Pininfarina in Italy. The experiences thus gained again constitute a safety potential which relates back to airplane propellers, for in the climate-controlled test sections, for example, the temperature is changed in a short time from about -40°C to +50°C. Such fan blades have been in use for many times 10,000 hours.

--Frost control blowers for fruit orchards use blades made with the Hoffmann composite construction method because these devices remain out in the open for 10, 15 years without service. Here experience from aviation technology again has a positive impact on devices located in the soil.

--In the same area we find impeller blades for wind energy plants. Many producers of such plants underestimate the problems of producing such blades. Special success was achieved in this area, for example, in cooperatin with the Siemens Co in Munich and Vienna on two different projects.

--The best proof, however, of the confidence in the wood-composite construction method was offered by the selection of Hoffmann propellers by respected hovercraft manufacturers.

Practically everything that is whirled up from the ground by the rotor or flies around in the air ends up in the plane of propeller rotation of such craft: sand, stones, pieces of ice, to say nothing of the torrents of water which additionally are especially corrosive when sea water is involved.

Such reversible 4-blade propellers, 3 meters in diameter, are being delivered for the Waertsilae Co in Finland. British Hovercraft, the world's leading company, is using a covered 4-blade propeller in its newest designs (88 seats). Recently a new foreign manufacturer joined in, for whom 5-blade, reversible propellers, 4 meters in diameter, are being manufactured for 1,350 kW driving power. Hoffmann was able to finish the order in only 8 months.

--The construction method of the blades, lacking negative forms, is also especially suitable for special designs. Thus, for example, RFB's Fantrainer has been flying for years with Hoffmann blades, and reversible 5-blade propellers are being delivered for the English non-rigid air ship SK 500.

--But at Hoffmann there is also the sector of "pure engineering activity," for example, measuring vibration stresses on propellers in flight for which there is a complete measuring system, or also for analyzing rotors, stators and coverings of covered propellers. For this they have their own Tektronix computer facility which also shows the profiles right away.

--The diversity of the tasks and the income thus produced permitted a restructuring within the company which after many years resulted in noticeable relief for the service sector. Service is supported by a separate pick-up service which is not limited by borders.

--Contracts with all respected propeller manufacturers of General Aviation and Commuter Class constitute the basis of this service work. Beyond that, the TRW-Hartzell Propeller Co will be the representative in respect to European aircraft manufacturers.

Research

Various research and development projects were supported in the past few years, partly from the Bundeswehr sector, the Ministry of Defense and finally from the Ministry for Research and Technology within the framework of the ZKP program.

In a carefully planned joint venture under the direction of the Dornier Co new kinds of propeller blades came into being at Hoffmann whose superior designs were developed in precise detailed work and in wind tunnel experiments together with the DFVLR [German Research and Development Institute for Air and Space Travel] in Goettingen and Braunschweig and the Stuttgart Technical University for a performance class of about 500 kW.

The flight testing of these new blades was done in Hartzell-Naben on the Dornier TNT test carrier. The results exceeded in part the improvements calculated in advance. Thrusts with "artificially eroded" leading edges were also measured in order to establish the efficiency loss with "worn out" blades. The natural change in the propeller leading edges which occurs through erosion during operation has a disruptive influence in the case of many types of designs.

With the new designs the thrust loss in this respect was, however, quite negligible--an additional big advantage of the new technology.

At Hoffmann the limits of the company's capacities are also known. The scope of this last mentioned research activity goes far beyond what a middle-level company can produce on its own with a limited market.

Therefore, it is especially noteworthy that public support and the coordinated cooperation of competent institutions under the direction of the Dornier Co have affected a success which means more than "just" connecting up with the level of knowledge of the Western industrial nations.

12124
CSO: 3102/268

TRANSPORTATION

HOW AIRBUS OVERTOOK BOEING, PROSPECTS FOR STAYING AHEAD

Hamburg DER SPIEGEL in German 31 May 82 pp 61-68

[Text] The competition between the European Airbus industry and the American Boeing concern is getting serious. All their competitors in civilian aircraft construction have now fallen by the wayside. The two companies now hope to corner the market between them which experts estimate will call for 3,600 new aircraft by the year 2000.

At 9:48 am on 3 April 1982, the prototype of the new Airbus A 310 landed safely at Toulouse airport following its first 3-hour test flight. As nervous as ever after a stressful experience, test pilot Bernard Ziegler, a onetime French Air Force ace, climbed out and said drily: "Everything we hoped for on this first A 310 flight has been achieved."

The European Airbus industry wishes to use the A 310, a smaller, technologically advanced version of the 250-seat A 300 with a seating capacity of 210, to make it big on the world market for large carriers and to take its place alongside previously predominant Boeing as its equal and sole competitor.

Airbus president, Bernard Lathière, who makes the other four members of the Airbus top management somewhat unhappy by assuming baroque airs, feels that this goal has already been reached. "We are biggest producers of wide-body aircraft in the world," he says.

The fact is that Airbus—a consortium dominated by the French and the Germans and supported by the Britain and Spain—managed to sell 55 percent of all wide-bodies in the world in 1981. The remainder was divided between Boeing and the two other American firms of McDonnell Douglas and Lockheed.

As recently as 1976, the Europeans managed to sell a mere 33 aircraft despite strong sales efforts and were forced to scale down production from four planes per month to just two per quarter.

Now, nine aircraft are being produced every 2 months which comes to six times as many as then. Starting in 1984, Airbus chief of production Hartmut Mehdorn has plans for producing eight aircraft per month.

The fact is that Airbus has been able to increase its share of the wide-body market year after year between 1976 and 1981.

In 1976, Airbus had no international standing and did not sell a single aircraft. One year later, it had already passed third-place Lockheed which was unable to make headway with its good-quality TriStar L 1011 against the McDonnell Douglas DC-10, which had gone into production somewhat earlier.

When Douglas had to scale down production on its tri-jet DC-10 after a series of accidents, Airbus advanced to second place on the civilian jet market.

And when Boeing, the previously undisputed leader, ran into difficulties as its long-time customer, the American airline industry, began to founder in 1981, Airbus even managed to pass Boeing in wide-body sales.

Starting in 1980, the U.S. airline industry would buy aircraft only if it absolutely had to and was even then opting for the smaller Boeing 727's and 737's. As a consequence, orders and profits of the West coast giant in Seattle went down. Meantime, Airbus was concluding big sales on the European, the African and above all the Asian market and gaining 44 airlines as customers.

In its fight for the market, it was of advantage to Airbus that it had been building the A 300 B, the most modern and most economical wide-bodied aircraft for short and middle distances since 1974.

Boeing will not be able to bring comparative types on the market until 1982 and 1984 respectively: the 210-seat Boeing 767 and the 180-seat Boeing 757. Starting in the spring of 1983, Airbus will counter by beginning delivery of the new 210-seat A 310 and starting in 1986 of the 150-seat A 320, which will have a narrower body.

No other aircraft manufacturer in the world will be able to bring comparable twin-jet aircraft for short and middle distances on the market by that time other than Boeing and Airbus. The two will be by themselves as they compete for a share of the world market which will call for about 3,600 such planes by the year 2000.

Under the circumstances, the sales departments of the two firms are already gearing up for the fight. The Airbus people are fast getting used to the rough style prevailing in the international aircraft business.

The French in particular are quite good at the "hard sell." "No sheik will open his door to you unless he gets a fat bribe," one insider has said. With sales running into the billions, 7-digit bribes are not unusual.

In their dealings with the Indonesian airline Garuda and with Singapore Airlines, Airbus was able to offer better credit terms than the American competition—above all with the help of guarantees by the French government.

In Tunisia, Boeing tried to counter with some tricks of its own. The Americans told Tunis Air—an airline obsessed with prestige considerations—that it would take as yet undelivered Airbuses off its hands at the original price, if the Tunisians would agree to buy four of the newly developed Boeing 767's instead.

The Tunisians thereupon went to Toulouse and asked for a large discount—which Airbus granted them. North Africa from Tunisia to Algeria to Egypt has since turned into still another Airbus market.

An air of panic seized the American aircraft industry which had been in the habit of looking down on the market and on its competitors. Studies were commissioned to find out why the Americans were doing so poorly.

But these studies only created more confusion. Technologically, the studies concluded, the Americans were on a par with the Europeans; the quality of their products was not inferior, and in management, service and sales they were clearly ahead. The reason the Europeans were doing so well was that their governments were supporting the Airbus Industry by extending interest subsidies and direct financial assistance.

But the role the European governments are playing cannot be the whole story. Both the American airplane industry and the U.S. government made one mistake after another with regard to aircraft types and airlines policy.

On the advice of his airlines administrator Alfred E Kahn, former President Carter introduced the "open sky" policy in 1978. Since then, the American airline industry has been engaged in a price war so fierce that there hardly is an airline today which can afford to buy new planes.

That is why oldtime Boeing customers began canceling long-standing orders last year.

United, Eastern and American Airlines called more than 130 orders and options for Boeing 767's and 757's into question, amounting to $5 billion. TWA spent most of its time looking into the used aircraft market.

Following the failure both of Laker Airways and Braniff, that particular market offers first-rate equipment at reduced prices. Already in April 1982, prior to the Braniff debacle, Boeing said there were 38 used Jumbos and 50 used Boeing 727's on the market.

The Boeing management itself shares in the responsibility for Airbus' success. While the Europeans went ahead with the production of twin-jet wide-bodied aircraft, Boeing respected the wishes of the American airline industry for a tri-jet type for some time. It was not until the Airbus had been flying for a good while that Boeing gave the green light for production of two twin-jet types which—to the amazement of the aircraft industry—are not far apart in seating capacity, taking on 210 and 180 passengers respectively.

The Europeans were also surprised about the fact that the body cross sections of the two Boeing planes were designed too small to accomodate the internationally standard-sized freight containers so as to take advantage of an insignificant aerodynamic feature. Any airline flying Boeing passenger jets thus cannot conduct a lucrative freight business on the side which would increase its earnings appreciably.

In cockpit electronics, too, the Americans dropped to second place. The video screen technology developed by the French electronics manufacturer Thomson-Brandt for the new Airbus twin cockpits is more efficient than that of the Americans. There was some resistance against the new technology by the pilots; but it quickly subsided. Starting in 1984, all Airbus planes will be equipped with twin cockpits exclusively.

But things could change rapidly, even very rapidly, if America's airlines would start buying again. Then, the major weaknesses of the Airbus organization—revelling in its current success—would become apparent.

The internal organization of the multinational concern—particularly its resilience with respect to the ups and downs of the market—is not as good as that of the Americans. There also are gaps in the production program. The projected four-jet, long-distance Airbus cannot be built at present for lack of funds. Airbus is only able to offer short and middle-distance jets.

At the Boeing plant in Seattle, jet aircraft of all sizes are being built in four parallel production lines. If the firm is hit with a decline in orders, one production line after another is shut down and the workers are fired. In this manner, Boeing can produce anywhere from 10 to 44 aircraft per month without going into the red.

Airbus is in the midst of the laborious process of setting up its second production line. For the Europeans, declining orders result in slower—which is to say, less economical—production on the existing line and workers cannot be fired from one day to the next.

Production costs of the Airbus are high because of the large and socially secure work force employed there as well as because of the large and costly inventories of semi-finished goods and of the complex transportation network connecting the production facilities located all over Europe. Despite its high $52 million price tag, the plane still costs its producers money.

The French Airbus partner, Aérospatiale, is in a position to absorb losses because the French government helps out; but the privately financed German partner, Messerschmitt-Boelkow-Blohm—which, like Aérospatiale, controls 37.5 percent of the business—is out to make a profit. But profits are not in sight despite the fact that 172 Airbuses have already been delivered, another 200 have been built and 507 more are on order.

But the Europeans are also faced with new costs because of the need for funding the A 320, which is to compete with Boeing on the smaller short and middle-distance aircraft market.

MBB, tired of incurring losses on the civilian market, therefore merely wants to pick up a 20 percent share of the A 320 with France and Great Britain opting for 30 percent. The remainder is being fought over by Italy, Spain, Canada, Belgium and, most recently, the Dutch firm of Fokker.

But this further complicates the organizational structure of the European aircraft industry. The A 300 and the A 310 are being built by fewer partners than the A 320.

Nor has agreement been reached on the engines for the new jet. For this reason, it is to be a joint undertaking involving Rolls-Royce of Great Britain, Pratt & Whitney of the United States, Motoren- und Turbinen Union of Germany and a Japanese group of firms.

Under the circumstances, the A 320 will not come on the market until 1986 at the earliest. By then, the Americans may well have beaten the Europeans to the punch on the hotly contested foreign markets, however, with their already available aircraft types or others about to go into production soon.

Observant Airbus managers have suddenly discovered the answer to the question of why the Americans are planning to build two new jet aircraft types of almost equal size despite high R & D costs for both. "They are going to use the 767 to get a share of the larger-volume market and the 757 for a share of the smaller-volume market," Mehdorn says.

Equipped to carry 210 passengers, the basic Boeing 767 model is to compete with the new 210-seat Airbus A 310. But the 767 can be lengthened to accomodate from 250 to 270 passengers and thus compete with the big A 300 B Airbus.

Equipped to carry 180 passengers, the basic Boeing 757 model can be shortened to provide room for only 150 passengers which makes it into a competitor of the two smaller A 310 and A 320 Airbus models. Boeing thus needs only two models to serve the middle-distance business of the future while Airbus needs three.

Those in the know at Airbus believe only the French would go through with such a new program that involves risks running into the billions come what may.

The chances are good that this will happen. The man who runs Aérospatiale is former general Jacques Mitterand who enjoys a reputation of being particularly obstinate. The man who runs France from the Elysée Palace is his brother, Francois Mitterand, who is just about as much of a chauvinist as his predecessor Charles de Gaulle. Both are intent on securing technological supremacy in Europe for France.

9478
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ADVANCED PASSENGER TRAIN PROJECT ENCOUNTERS DIFFICULTIES

Paris SCIENCES & AVENIR in French Mar 82 pp 24-25

[Text] In principle, the Glasgow to London APT (Advanced Passenger Train) was to have begun service in the fall of 1979. However, trial runs made that spring proved disappointing. The British transport minister took a short ride on this rival to the French TGV (High-Speed Train) in September 1980 and announced that service would begin "before the end of the year." Once again, however, the starting date was pushed back, to be "definitively" set for 11 January 1982. Now, the FINANCIAL TIMES reveals that in high quarters they are thinking of entirely abandoning the venture.

The last trial runs, made in December 1981, were a disaster. The British Railways had decided to make six round trips on the Glasgow-London line with the ATP over a period of 15 days in order to prove its effectiveness before putting it into service on 11 January. The first trip went well. During the second, an automatic switch was activated, preventing the functioning of the "pendulum" system, chief innovation of the high-speed train. In effect, the body of the train must "lean" up to 9 degrees on curves. With this capacity suddenly lost, teacups began to fly. During the third run, the secondary braking system, intended to stop the train once the speed drops to 80 km/hr, quit in its turn: the lines had frozen. On the fourth trip, the train was halted by snow.

Conceived in 1967, put on the books in 1969, the APT has not stopped having problems. First it was the motorman's station which seemed uncomfortable to the unions. Then the planned gas turbine drive had to be replaced by an electric one, after which the pendulum system had to be modified twice. Now it seems that the third version is still not ready. The braking system, dubbed "hydrokinetic", is especially complicated, and has proven delicate.

British Railways, which still has not entirely given up hope, is seriously considering a replacement: a slower, more conventional train. This would avoid having to solve another problem: for weak stomachs, the pendulum system turns out to be just as terrible as a rough Channel crossing.

9939
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TRANSPORTATION

BRIEFS

DORNIER DO 228 CRASHES--Near Igenhausen in Land district Aichach, Upper Bavaria, on 26 March 1982 a multipurpose and feeder airplane of the Dornier 228-100 type crashed during a test flight. The three crew members on board were killed; they were Dornier test pilot Dieter Beckmann (43) and two officials of the British aviation authority, the CAA--Civil Aviation Authority. The flight, which took off from the factory's airfield at Oberpfaffenhofen at 1727 hours, was being carried out as part of the program for British type approval. Since its first flight on 28 March 1981 the prototype, which was equipped with two turboprop engines, had completed 180 flights and 210 hours in the air. Type approval by the German national aviation office for this 15-passenger commuter aircraft was issued at the end of 1981. The further circumstances and the cause of the accident are currently under investigation by the responsible authorities. According to an initial statement by the responsible authorities there is no intention of withdrawing the type approval nor of restricting the current scope of approval since according to what can be said at the moment the accident does not appear to have a technical cause. Almost the entire course of the accident was telemetrically recorded. The accident took place in the course of a flight phase in which, among other things, the job was to simulate a failure of the trim. In order to guarantee the continuation of the approval flights, the Norwegian airline AS Norving has indicated its readiness to make its just recently received Do 228 available to Dornier for upcoming approval flights by foreign authorities. [Text] [Gelsenkirchen AEROKURIER in German Apr 82 p 384] 12124

VW INDUSTRIAL ROBOTS--There has been a steady increase in the use of industrial robots in the past few years in the Volkswagen conglomerate. At present about 570 such automatic operating devices are in use in the various VW factories, with approximately half of them at the main factory in Wolfsburg. The intention is to increase the number of robots at VW to about 800 this year; at present the main thrust of this is the installation of such automatic devices at Audi/NSU in the Ingolstadt and Neckarsulm factories. Welding and handling operations are the focal point. The costs of such an automatic device, according to information from experts, ranges between DM120,000 to over DM200,000, depending on efficiency and design. VW developed the robots, which are in use, for the special requirements of its own manufacturing and will itself in the future also build the equipment necessary for these needs. The capacities for robot production are designed for about 12 devices per week. In this sector VW involves between 130 and 150 staff workers in planning, design and manufacture. [Text] [Essen ELEKTRO-ANZEIGER in German No 6, Mar 82 p 8] 12124

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CSO: 3102/268